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Research Article

Observation of Plant Genetic Resources of *Sorbus domestica* L. in Bulgaria

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The service tree (*Sorbus domestica* L.) is a fruit-bearing tree that is distributed in Central and Southern Europe, North Africa and Asia Minor. A detailed study of the distribution in Bulgaria of 246 specimens, characteristics and propagation was published in 1990. For over 30 years the species has been overlooked by the scientists. Our investigations can confirm the good phytosanitary and physiological conditions of 10 specimens described 30 years ago and revealed 91 new fruit-bearing trees. We found a great phenotypic diversity in shape, size, colour and taste, similar to those found in other European countries. A total of 101 trees are subject to monitoring and preservation in the areas of Gotse Delchev, Varna, Burgas, Plovdiv, Kyustendil, Sandanski, Stara planina mountain, and Sredna gora mountain. There are currently 9 new described habitats of fruit-bearing trees and the research goes on. As a result of the present survey, the species has been found to occur mainly in wild conditions in semi-mountainous areas. Most trees are old and fruit-bearing. In recent years there has been an increased interest in cultivating the species on private farms. These trees are seedlings, mostly young and not bearing fruit yet.

Keywords: plant genetic resources, *Sorbus domestica* L., distribution

1 Introduction

1.1 Origin and historical data

The service tree (*Sorbus domestica* L.) is a fruit-bearing tree that is distributed in Central and Southern Europe, North Africa and Asia Minor. It is also found on the Crimean Peninsula (Kausch-Blecken von Schmeling, 2000).

It is found in pre-mountain areas and on flat terrain because of its need for light and relatively moderate temperatures. It is usually not accompanied by other species as it has low competitiveness. It prefers sparse forests and open spaces (Rotach, 2003).

Excavations carried out in Bulgarian caves and the preserved plant remains prove that people used the fruits of the service tree as food as early as during the Upper Paleolithic. The results of research in some Thracian settlements show that the service tree was also used as food in the period from the 17th to the 15th century BC (Mondeshka, 1996).

In Antiquity, the Romans cultivated the species widely and spread it to north of the Alps (Luke, 1986). Mondeshka (1990) quotes the so-called Koncinski Practik from the 14th century, which shows that in the late Middle Ages the service tree was one of the main fruit-bearing species in Bulgaria, together with the walnut, cherry, mulberry, pear and apple, and was grown more frequently than the plum and dogwood. There were separate plantations of *Sorbus domestica* (Mondeshka, 1990). The service tree was also presented at the First National Fruit Growing Competition after the Liberation of Bulgaria, held in 1896 in the town of Kyustendil (Mitev, 1978).

1.2 Biological Characteristics and Uses

It is especially valuable for its solid, heavy, and strong wood (880 kg.m^{-3}), making it the heaviest of all European wood species. The wood is difficult to split, tough, elastic, easy to work and polish, it is stable and does not crack easily. It is used in the furniture industry, for the production

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of lathes, screws, etc (Kausch-Blecken von Schmeling, 2000). The tree is honey-bearing, and the inflorescences also have antibacterial properties (Lykholat et al., 2023).

Fruits vary in shape, size, colour, and taste. They are used for fresh consumption, for improving the condition of the digestive system, and as an additive for conserving apple cider (Rotach, 2003). They are also suitable for diabetics due to the low sucrose content. The fruits have a high content of fructose, glucose, vitamins and pectin and are used to make jams, compotes, jellies and preserves. In Bulgaria, products such as nectar, flour, mousse, sugared fruits and pestil are also known (Mondeshka, 1990).

The longevity of this tree is outstanding – it can live up to 500 years (Mondeshka, 1990). It starts bearing fruit late, which is not favourable to the commercial interest of large producers. The industrialisation of agriculture and intensive land use gradually reduced the cultivation of *Sorbus domestica* in the 19th and especially in the 20th century (Bignami & Bertazza, 2005). Today the species is rare and in many places endangered (Frochot et al., 2008` Enescu et al., 2016).

1.3 Contemporary status and research

Interest in the true service tree was revived in Europe in the 1990s. Various programmes and initiatives for raising the public awareness of the species took place in Germany, Hungary, the Czech Republic in 2015, etc. (Kausch-Blecken von Schmeling, 2000; Hrdoušek, 2015). In the 1980s, the species was identified as endangered in Bulgaria (Mondeshka, 1990).

A detailed study of the distribution in Bulgaria, characteristics, propagation and production of planting material was published in 1990 by P. Mondeshka. For over 30 years the species has been overlooked by the scientists. A few contemporary publications present analysis of trees from several locations in 2013 and 2015 (Georgiev, 2013; George et al., 2015 a, b, c). The quality of mixed fruits from various origin is analysed thanks to the National Research Programme "Healthy Foods for a Strong Bio-Economy and Quality of Life" published in 2022 (Ognyanov et al., 2022).

Modern methods of analysis can fully identify the substances useful for the pharmacological and food industry. The diversity of the different specimens is due both to predominantly sexual reproduction by seed and to the lack of selection so far in this species. Establishing the location and condition of the available trees in Bulgaria is the start of a larger study of the possibilities for restoring the species and using it in breeding and other scientific programmes.

2 Material and Methods

Information on the existing diversity within the species was obtained from the thesis of Mondeshka (1990). Additional data is collected from literature sources in journals online and on paper.

Online and personal interviews were conducted in the period 2022–2024. Information is collected about the existing specimens and their condition – age, habitat, whether they are alone or in a group, fruits – coloration, size, and shape.

Fruit samples were collected underneath the trees. The fruits vary in size and are divided based on weight into small (5–10 g), medium (11–15 g) and large (16–20 g) according to Drvodelić et al. (2018). The weight was calculated as the average of weighing 40 fruits from each tree on a laboratory scales KERN EMB 600-2 with the accuracy of 0.01 g.

Monitoring of the present accessions was conducted during expeditions in the spring of 2024 (March-May). Collected data are summarized and presented here.

3 Results and discussion

246 specimens of *Sorbus domestica* L. were discovered in the 1980s in Bulgaria in the regions of Troyan, Lovech, Vratsa, Montana, Gabrovo, Veliko Tarnovo, Kyustendil, Sandanski, Sredna gora mountain, Strandja mountain, Eastern Stara planina mountain, Eastern Rhodopes and around Varna (Mondeshka, 1990).

In 2013, Georgiev described 38 trees in the Eastern Stara planina mountain, of which he identified 6 individuals as the most promising for seed production to enrich the forest fund and to increase the numbers of nectar-producing and fruit-bearing trees in forests (Georgiev, 2013).

In 2015 George et al. analysed samples from trees found in the regions of Strandja mountain, Kresna, Blagoevgrad, Petrohan and Belogradchik. According to the molecular markers analyses (one chloroplast minisatellite (22 bp repeat) and seven nuclear microsatellites (CG-repeat) they established low to moderate levels of differentiation and a weak genetic structure in *S. domestica* across Bulgaria in the nuclear DNA (George et al., 2015c).

As a result of the information collected so far (Fig. 1), we can confirm the good phytosanitary and physiological condition of 10 of the trees, described in 1990.

We identified 101 fruit-bearing trees. 91 of them are new and previously unreported. All trees, including the 10 confirmed from 30 years ago are presented in Fig. 2.

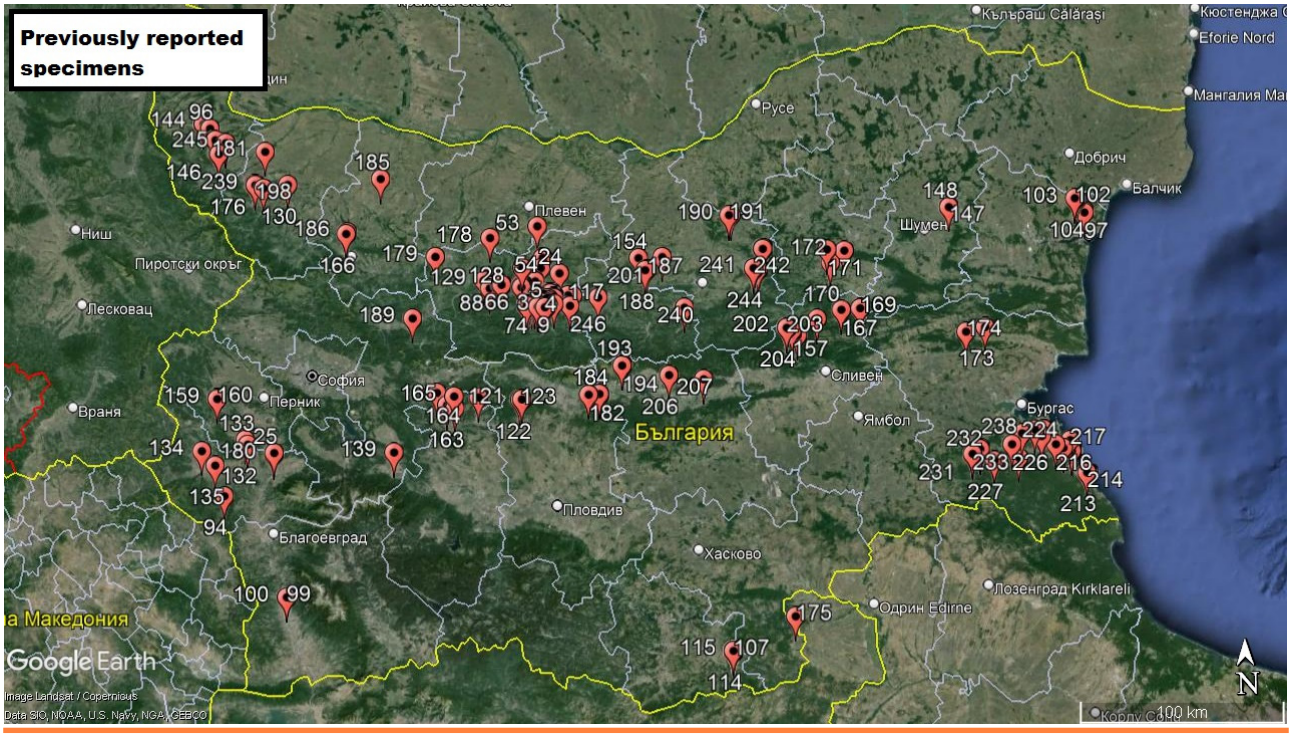

Figure 1 The 246 specimens described by Mondeshka (1990)

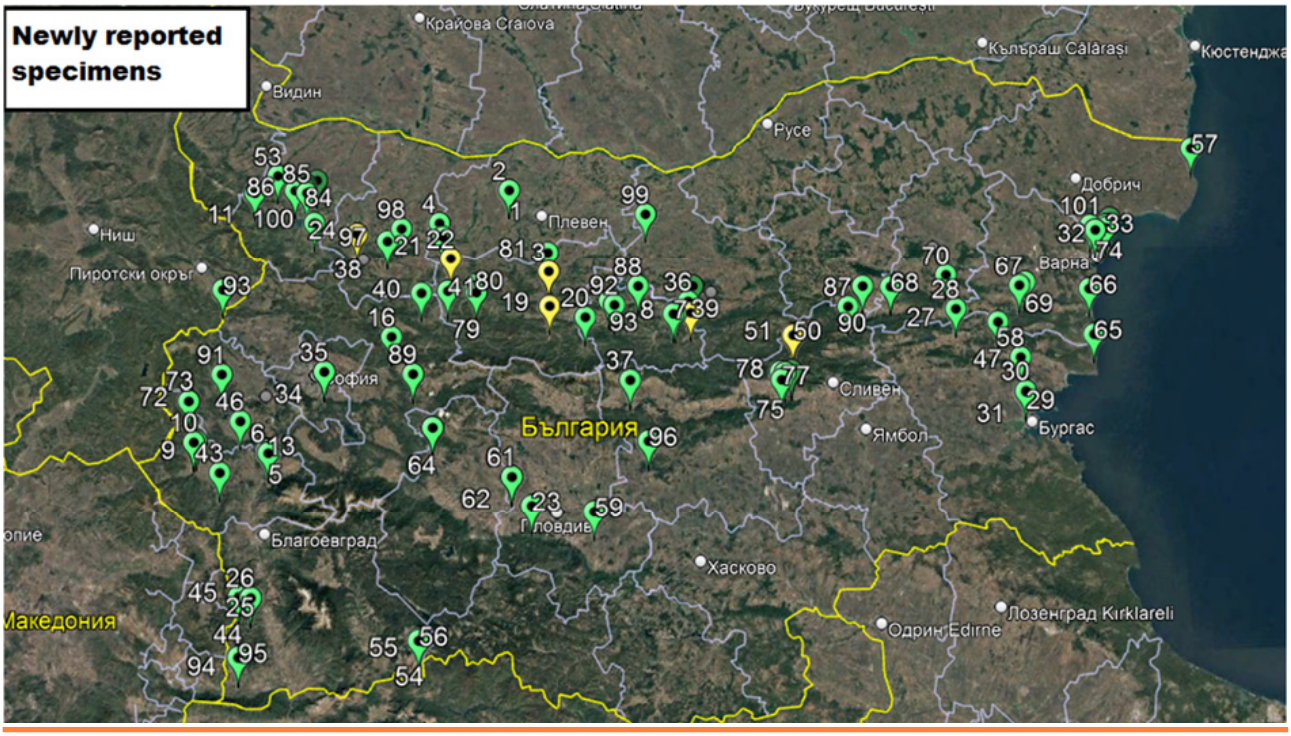

Figure 2 The 101 newly reported specimens (green) including the 10 confirmed ones (yellow)

We also found new locations where it was not known that service trees grow – these are the areas of Plovdiv, Gotse Delchev, Petrich, Zemen, Dragoman, Ihtimanska Sredna gora, Tryavna, Burgas, Shivachevo.

New locations with old fruit-bearing trees:

- Century-old trees – single trees in the region of Vratsa, Montana and Botevgrad – 4 trees in total in Northwestern Bulgaria.
- 4 century-old single specimens in the Central Stara planina mountain, Central Bulgaria.
- 1 century-old grafted specimen in the area of Gotse Delchev, Southwestern Bulgaria (Fig. 3).

Old fruit-bearing, 40–100 years old – 92 specimens in the regions of Gotse Delchev, Plovdiv, Petrich, Kyustendil, Montana, Ihtimanska Sredna gora mountain, Gabrovo, Eastern Stara planina mountain, Varna and Shivachevo.

We also discovered the existance of 17 young, yet not fruit-bearing trees mostly in private farms in different parts of the country (Fig. 4).

According to Kárpáti (1960) there are three main forms of the fruits – pyrifera, pomifera, domestica.

According to the data we have collected, all forms are represented in Bulgaria:

- forma pomifera – 7 specimens in the regions of Gabrovo, Pleven, Sevlievo and Dupnitsa;
- forma pyrifera – 9 specimens in the regions of Troyan, Gabrovo, Plovdiv and Dupnitsa;
- forma domestica – 6 specimens in the regions of Kyustendil, Sliven, Montana and Varna.

According to the size of the fruit the genotypes can be described as small (5–10 g), medium (11–15 g), and large (16–20 g):

- small – 5 specimens in the region of Vratsa, Dupnitsa and Kyustendil;
- medium – 4 specimens in the region of Kyustendil, Burgas, Plovdiv;
- large – 10 specimens in the region of Troyan, Sliven, Dupnitsa, Gabrovo.

According to the coloration the genotypes can be described as:

- red – 1 in the area of Sliven;
- yellow – 10 in the region of Plovdiv, Burgas, Montana, Dupnitsa, Troyan and Varna (Fig. 5);
- orange – 1 in the region of Troyan;
- green-red – 1 in the region of Gabrovo;
- yellow-red – 5 in the region of Sevlievo (Fig. 6);
- yellow-orange – 1 in the region of Gabrovo.

Figure 3 Century-old grafted service tree in the area of Gotse Delchev, Bulgaria

Figure 4 Young tree not bearing fruit yet, Bulgaria

Figure 5 Yellow fruits in the region of Montana, Bulgaria

Figure 6 Yellow-red fruits in the region of Sevlievo, Bulgaria

Six trees with oval fruits, seven trees with apple-shaped and nine with pear-shaped fruits were found, similar to those found in other European countries and published for example by Kárpáti (1960) in Hungary, Hrdoušek (2015) in the Czech Republic and Bignami (2000) in Italy. The reported trees are in the regions of Plovdiv, Troyan, Pleven, Gabrovo, Dupnitsa, Kyustendil, Sliven, Montana, Sevlievo and Varna. The fruits of the remaining trees are yet to be studied.

Almost all of the newly described trees grow alone, very few of them are in groups such as in the area of Gotse Delchev, Plovdiv and Sliven. This confirms the foundings of Rotach (2003) that the populations of this species are fragmentary.

Seeds are used as a main propagation method for the new trees that are found mainly in private gardens. Root suckers prove unreliable when transplanted to a new site and die within a few years before starting to bear fruit. This is most likely because the central root is being injured during the digging.

The sexual process determines genetic variation, demonstrated by the diversity of the fruits found in the country. This is a good prerequisite for the selection of larger fruits with better quality. It should be kept in mind that the stable inheritance of fruit quality can only take place through clones – cuttings or buds grafted onto suitable rootstocks.

4 Conclusions

In Bulgaria, a great phenotypic diversity in shape, size, colour and taste of the fruits of *Sorbus domestica* L. has been found, similar to those found in other European countries.

A total of 101 trees are subject of monitoring and preservation in the areas of Gotse Delchev, Varna, Burgas, Plovdiv, Kyustendil, Sandanski, Stara planina mountain and Sredna gora mountain.

The location and good phytosanitary and physiological conditions of 10 specimens described 30 years ago has been confirmed.

There are currently 9 new described habitats of fruit-bearing trees. The research goes on.

As a result of the present survey, the species has been found to occur mainly in wild conditions in semi-mountainous areas. Most trees are old and fruit-bearing.

In recent years there has been an increased interest in cultivating the species on private farms. These trees are seedlings, mostly young and not bearing fruit yet.

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