

FRUIT TREES AS IMPORTANT ELEMENTS OF URBAN GREEN SQUARES' VEGETATION – ON THE EXAMPLE OF THE MOKOTÓW DISTRICT IN WARSAW, POLAND

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Abstract

Fruit trees in urban green areas become an alternative method of urban gardening and edible landscape appreciated by city residents. The aim of the study was to identify fruit trees in green squares in the Mokotów district in Warsaw, Poland. Their quantitative share among deciduous trees was identified in general and by species. Changes in the number of plantings of selected species divided into periods (before 2000, in 2000-2019 and 2020-2023) were also recognized. The results show that fruit trees grow in 16 out of 18 squares and currently constitute from 2.0 to 75.0% of deciduous species, with an average share of 24.5%. Most species with edible fruit were planted before 2000 (e.g. *Malus domestica*). In the years 2000-2019, the number of fruit trees increased mainly through the planting of ornamental varieties (with inedible fruit, e.g. *Prunus serrulata* 'Kanzan'). The share of trees with edible fruits has increased since 2020, but the diversity of species has reduced – new plantings are dominated by selected species and their varieties (mainly ornamental apple trees, e.g. *Malus* 'Evereste'). The increasing number of fruit trees has a positive impact on the biodiversity of green squares and development of edible landscape.

Keywords: trees, urban green areas, biodiversity, urban orchard, edible landscape

Introduction

Fruit trees play an important role in the city by providing numerous ecosystem services. In particular, they contribute to increasing biodiversity, offer shelter for birds and insects, and improve the aesthetics of urban space (Winkler et al., 2023). They are also part of the edible landscape (Lafontaine-Messier et al., 2016; Rada et al., 2022). Therefore, the preservation and care of fruit trees are important to improve the functioning of the urban environment, green areas (Kimic et al., 2023), as well as the health and well-being of communities (Colinas et al., 2019).

The history of growing fruit trees in cities dates back to antiquity, but in the following centuries they were planted only in private gardens. They began to be introduced into cities in the 19th century, planted along streets and in public parks (Kimic, 2019). And although the share of these plants decreased in the following decades, at the end of the 20th century the fruit-growing tradition was restored to counteract climatic and economic problems. Old fruit trees have been preserved in many public parks, and they are increasingly introduced in the form of organized urban orchards combining decorative and utilitarian functions (Lisandru et al., 2016). The importance of these trees for the sustainable development of cities is appreciated in the 21st century. Orchard varieties of fruit trees can be found in many green areas (Sobieralska, 2004). Initiatives such as plant mapping and the creation of community gardens are organized (Poe et al., 2014; Colinas et al., 2019; Bihuňová et al., 2021). Many old specimens of fruit trees have been preserved in Warsaw (Kimic, 2021), and new ones are being planted in various public spaces (Agenda 2030..., 2015).

The aim of the study was to identify fruit trees in squares in the Mokotów district in Warsaw and determine their share among all deciduous trees, along with their division into species. This made it possible to analyse changes in the number of planted trees of various species and show leading trends in their selection in 3 periods: before 2000, in 2000-2019 and 2020-2023.

Material and methods

The area of research on the identification of fruit trees included 16 out of all 18 squares in the Mokotów district in Warsaw – 2 squares devoid of these plants were omitted. The initial

collection of information on the occurrence of fruit trees in squares was based on the analysis of data from the map service of the capital city of Warsaw (Mapa koron drzew (zielen), 2023). The current status was verified as part of field visits carried out in the squares from June to December 2023. As part of the inventory, data on the number of trees and species was collected, and measurements of the trunk diameter at breast height of each tree were made to estimate its age. To determine the time of planting trees, historical aerial photos from 1976-2023 available in the map service of the capital city of Warsaw (Mapa historyczna, 2023) and images from Google Street View were analysed. On this basis, three periods of planting fruit trees were indicated, for which a detailed species composition was established: before 2000, in 2000-2019 and from 2019 to the end of 2023.

Results

At the end of 2023, a total of 319 fruit trees of 10 species were identified in 16 squares in the Mokotów district in Warsaw (Table 1). The dominant ones are: *Pyrus* sp. (6.3%), *Sambucus* sp. [8.5%] and *Sorbus* sp. [8.5%], *Crataegus* sp. [9.7%], *Malus* sp. [13.2%], *Prunus* sp. [48.9%]. Less numerous species include: *Elaeagnus* sp. [0.3%], *Mespilus* sp. [0.3%], *Morus* sp. [2.2%], as well as *Juglans* sp. [2.2%], which constitutes mainly self-seeding.

Tab. 1: Number of fruit trees in squares in the Mokotów district in Warsaw (as at the end of 2023).

Fruit tree species	Square name															
	A. Stolarski	A. Steinsbergowa	B. Broniewski "Orsza"	Chorwacki	Grupy AK "Granat"	Gwiazda Polski	J. Brzeska	J. Kaczmarek	M. Zimińska	O. and A. Małkowskich	Ormiański	Pokolenia Kolumbów	at Gościńiec Str.	at Marynarska Str.	Słoweński	Starych Panów
<i>Crataegus</i> sp.											9	5		2	1	1
<i>Crataegus x media</i>	1				8	3					1					
<i>Elaeagnus angustifolia</i>												1				
<i>Juglans regia</i>	1	1										5				
<i>Malus</i> sp.	4				2							4				1
<i>Malus baccata</i>											1					
<i>Malus domestica</i>											1					
<i>Malus floribunda</i>																1
<i>Malus sylvestris</i>												1		3	4	
<i>Malus x purpurea</i>						1					2	2				3
<i>Malus x purpurea</i> 'Ola'	2															
<i>Malus</i> 'Evereste'						1					2					
<i>Malus</i> 'Royalty'						5										
<i>Malus</i> 'Rudolph'						2										
<i>Mespilus germanica</i>											1					
<i>Morus alba</i>							7									
<i>Prunus</i> sp.												1				1
<i>Prunus cerasifera</i>		2			10	9	1			7	21	28				4
<i>Prunus cerasifera</i> 'Pissardii'						11							9			
<i>Prunus cerasus</i>	31														2	
<i>Prunus domestica</i>	1															
<i>Prunus padus</i>												1				
<i>Prunus serrulata</i>															3	
<i>Prunus serrulata</i> 'Kanzan'				2						5		4				
<i>Prunus spinosa</i>											3					
<i>Pyrus</i> sp.					1					1						1
<i>Pyrus calleryana</i>							2							4		
<i>Pyrus calleryana</i> 'Redspire'						2										
<i>Pyrus calleryana</i> 'Chanticleer'										3						
<i>Pyrus pyrastrer</i>	1										2	1		2		
<i>Sambucus nigra</i>	13		1		1	3	2			3		2		1		1
<i>Sorbus aucuparia</i>						1	1					2				
<i>Sorbus aucuparia</i> 'Pendula'										12						
<i>Sorbus intermedia</i>						1				5	5					

The analysis of the species composition of fruit trees showed that at the end of 2023, they constituted from 2.0 to 75.0% of the deciduous stand, with their average share being 24.5%. Only in 4 squares the share of fruit trees was below 10.0% (T. Szewczenko Square [7.5%], A. Steinsbergowa Square [6.0%], Chorwacki Square [6.3%], S. Broniewski 'Orsza' Square [2.8%]). The green structure of most squares included from 10 to 50% fruit trees. Only in two squares this share was above 50% and these are: Gwiazda Polski Square [50%] and the square at Gościńiec Str. [75%].

The analysis of the share of fruit trees in relation to all deciduous trees indicated that in the largest squares (area >1.8 ha) their share ranged from 14.4 to 32.2% (Grupy AK 'Granat' Square [14.4%], O. and A. Małkowskich Square [19.0%], Ormiański Square [28.7%], Pokolenia Columbusów Square [32.2%]). However, for the remaining squares (area <1.8 ha), this range was from 2.0 to 75.0%. At the same time, only 4 of them had more than 32.2% of fruit trees in the plant structure (A. Słonimski Square [38.8%], Słoweński Square [43.5%], Gwiazda Polski Square [50.0%], the square at Gościńiec Str. [75.0%]). The share of fruit trees in the largest squares is not the highest due to the large number of other species. At the same time, these facilities have from 22 to 57 fruit trees, which is one of the highest results in the ranking. Gwiazda Polski Square has a large number of fruit trees (39) with a high share of deciduous trees, and A. Słonimski Square – despite the average share of fruit trees – has as many as 54 of them. In the remaining squares, the number of fruit trees ranges from 1 to 13, which is the lowest share.

The obtained results also indicate a significant correlation between the area of squares and the number of fruit tree species (Table 2). Squares with a larger area are characterized by greater species diversity, which results from greater availability of space for planting and diversity of habitat conditions. The number of species in these facilities ranges from 5 to 14. Also the above-mentioned Gwiazda Polski Square and A. Słonimski Square fall within this range. In the remaining squares there are on average 1 to 5 species of fruit trees.

Tab. 2: The share of fruit tree species in relation to other deciduous tree species in squares in the Mokotów district in Warsaw - trends in changes of new plantings in the period before and after 2019.

Period	Square (area [ha])																	
	0,95	0,26	0,47	0,27	1,80	0,63	0,48	0,10	0,42	2,00	2,05	1,78	0,06	0,78	0,26	0,45	0,56	0,17
	A. Słonimski	A. Steinsbergowa	B. Broniewski "Orsza"	Chorwacki	Grupy AK "Granat"	Gwiazda Polski	J. Brzeska	J. Kaczmarek	M. Ziemińska	O. and A. Małkowskich	Ormiański	Pokolenia Columbusów	at Gościńiec Str.	at Marynarska Str.	Słoweński	Starych Panów	T. Szewczenko	W. Lipiński
before 2019	51 (78)	3 (46)	1 (40)	0 (26)	22 (125)	24 (38)	10 (33)	0 (13)	0 (0)	22 (146)	44 (96)	51 (113)	0 (1)	8 (55)	10 (13)	8 (48)	3 (31)	2 (12)
2019 2023	3 (7)	0 (1)	0 (3)	2 (4)	0 (6)	15 (1)	3 (3)	0 (0)	0 (13)	14 (7)	4 (23)	6 (7)	9 (2)	4 (18)	0 (0)	0 (3)	0 (6)	0 (0)
Total	54 (85)	3 (47)	1 (43)	2 (30)	22 (131)	39 (39)	13 (36)	0 (13)	0 (13)	36 (153)	48 (119)	57 (120)	9 (3)	12 (73)	10 (13)	8 (51)	3 (37)	2 (12)

X – number of fruit trees; (X) – number of other deciduous tree species

Most trees with edible fruit were planted before 2000 and they constitute 22.1% of the fruit species introduced then (e.g. *Malus* sp., *Malus domestica*, *Malus sylvestris*, *Morus alba*, *Prunus cerasifera*, *Prunus cerasus*, *Prunus padus*, *Pyrus pyrausta*, *Sambucus nigra*) (Table 3). Between 2000 and 2019, the increase in the number of fruit trees included mainly ornamental varieties (especially those with inedible or less tasty fruit, e.g. *Prunus serrulata* 'Kanzan', *Sorbus intermedia*). Since 2020, the share of fruit-bearing trees has increased, as opposed to species diversity. The new plantings were dominated by selected species and their varieties, especially cherries, accounting for 41.7% of the specimens (e.g. *Prunus cerasifera* 'Pissardii') or ornamental apple trees (e.g. *Malus* 'Evereste', *Malus* 'Royalty', *Malus* 'Rudolph'), which

accounted for 20.0%. A similar situation concerned pear trees, which constituted 18.3% of the plant selection, with the dominance of selected species and their varieties (e.g. *Pyrus calleryana* 'Redspire', *Pyrus calleryana* 'Chanticleer'). The remaining species of fruit trees were scarce and also included selected varieties (e.g. *Sorbus aucuparia* 'Pendula') that favor the existence of animals.

Discussion

Identification of fruit trees in individual squares in the Mokotów district in Warsaw showed quite large differences in their number, species and share. It should be noted, however, that the average share of fruit trees at the level of 24.5% is important for supporting biodiversity within small ecosystems such as squares (Rada et al., 2022). Most trees with edible fruit were planted before 2000, which confirms the high awareness of the importance of these plants among green area managers, which is so important for promoting a sustainable approach. However, a disturbing phenomenon is the reduction in the diversity of fruit trees in favor of the dominance of ornamental species over fruiting ones (including those bearing edible fruit) in the period 2000-2019. This could be the result of increased investments in planting trees that require less maintenance. However, the increasing share of fruit trees in squares since 2020 should be positively assessed. This is consistent with the general trends in shaping the vegetation of urban green areas in recent years (Kimic, 2019) and the growing interest of the local community in growing edible plants (McLain et al., 2014; Lafontaine-Messier et al., 2016), while supporting sustainable development and self-sufficiency of cities (Agenda 2030..., 2015).

Tab. 3: Number of fruit trees planted in the following periods: before 2000, 2000-2019 and 2020-2023.

	Period	Fruit tree species																																			
		<i>Crataegus</i> sp.	<i>Crataegus</i> x <i>media</i>	<i>Elaeagnus angustifolia</i>	<i>Juglans regia</i>	<i>Malus</i> sp.	<i>Malus baccata</i>	<i>Malus domestica</i>	<i>Malus floribunda</i>	<i>Malus sylvestris</i>	<i>Malus</i> x <i>purpurea</i>	<i>Malus</i> x <i>purpurea</i> 'Ola'	<i>Malus</i> 'Evereste'	<i>Malus</i> 'Royalty'	<i>Malus</i> 'Rudolph'	<i>Mespilus germanica</i>	<i>Morus alba</i>	<i>Prunus</i> sp.	<i>Prunus cerasifera</i>	<i>Prunus cerasifera</i> 'Pissardii'	<i>Prunus cerasus</i>	<i>Prunus domestica</i>	<i>Prunus padus</i>	<i>Prunus serrulata</i>	<i>Prunus serrulata</i> 'Kanzan'	<i>Prunus spinosa</i>	<i>Pyrus</i> sp.	<i>Pyrus calleryana</i>	<i>Pyrus calleryana</i> 'Redspire'	<i>Pyrus calleryana</i>	<i>Pyrus pyraister</i>	<i>Sambucus nigra</i>	<i>Sorbus aucuparia</i>	<i>Sorbus aucuparia</i> 'Pendula'	<i>Sorbus intermedia</i>	Total	
2020-2023	2	16	11	1	6	11	1	1	8	8						7	2	76	7	33		1					3					6	27	1	11	238	
2000-2019	2				1																1		3	5	3									1	5	21	
											2	3	5	2	1			6	13					6			6	2	3					2	1	6	60

Conclusions

The identification of fruit trees in squares in the Mokotów district in Warsaw indicates their significant share among the vegetation of these small green areas, which is important for shaping a sustainable urban landscape, especially on a local scale. The trends of the last four years aimed at increasing the share of fruit-bearing species, which slowed down in the period 2000-2019, should also be assessed positively.

The obtained results are crucial for managing squares in the district, in particular making decisions regarding the location of new plantings and the care of existing fruit trees. Increasing the share of plants from this group, especially in those squares where there are none or few of them, will support biodiversity. At the same time, it is crucial to maintain a balance between the share of ornamental and fruiting species, including those bearing edible fruit, in order to increase the environmental value of squares and make this unique edible landscape available to residents.

It should also be noted that research on the identification of fruit trees in squares initiated in one area of Warsaw should be continued in this type of green areas in other districts. Expanding

knowledge about the share of these plants will allow for systemic management of squares, increasing their attractiveness in the context of providing ecosystem services locally and on a city-wide scale.

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Souhrn

Ovocné stromy v městské zeleni se stávají alternativní metodou městského zahradničení a jedlé krajiny, kterou oceňují obyvatelé měst. Cílem studie bylo identifikovat ovocné stromy na zelených plochách ve čtvrti Mokotów v polské Varšavě. Jejich kvantitativní podíl mezi listnatými stromy byl zjišťován obecně a podle druhů. Byly také rozpoznány změny v počtu výsadeb

vybraných druhů rozdělených do období (před rokem 2000, v letech 2000-2019 a 2020-2023). Výsledky ukazují, že ovocné stromy rostou v 16 z 18 čtverců a v současnosti tvoří od 2,0 do 75,0 % listnatých druhů, přičemž průměrný podíl činí 24,5 %. Většina druhů s jedlými plody byla vysazena před rokem 2000 (např. *Malus domestica*). V letech 2000-2019 se počet ovocných stromů zvýšil především výsadbou okrasných druhů (s nejedlými plody, např. *Prunus serrulata* 'Kanzan'). Od roku 2020 se podíl stromů s jedlými plody zvýšil, ale snížila se druhová rozmanitost - v nových výsadbách převažují vybrané druhy a jejich odrůdy (především okrasné jabloně, např. *Malus* 'Evereste'). Zvyšující se počet ovocných stromů má pozitivní vliv na biodiverzitu zelených ploch a rozvoj jedlé krajiny.

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