

Original Research

***Pyracantha angustifolia* (Franch.) C.K.SCHNEID. A NEW EXOTIC SPECIES IN THE
DENDROFLORA OF BELGRADE**

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Abstract

*The study examines the condition and visual characteristics of *Pyracantha angustifolia* (Franch.) C.K. Schneid., a newly recorded taxon in the dendroflora of Belgrade. The recorded taxon has been present at the study site for 10 years, demonstrating remarkable resilience as well as excellent aesthetic qualities. Morphometric traits of the evergreen leaves, flowers, and fruits were analysed, along with flowering and fruiting abundance, which contribute to the attractiveness of green spaces in the urban landscape, where this taxon plays an important role as a border element in landscape architectural compositions. The dimensions of the analysed morphological characteristics of *P. angustifolia* fell within the range reported in the literature for its natural habitat. These results are important for the continued monitoring of *P. angustifolia*, as the species has shown invasive tendencies in some countries, which could threaten local biodiversity if left unmanaged. Moreover, the study highlights the significance of this taxon for bird feeding and habitat provision, particularly for house sparrows, whose populations are negatively affected by excessive urbanisation.*

Keywords: narrowleaf firethorn, introduction, morphology, visual characteristics, landscape design.

INTRODUCTION

The plant world is highly diverse, and in design there is often a focus on using new and more attractive taxa. As a result, urban dendroflora is very dynamic and rich in introduced species. Green spaces are designed to fulfil various ecosystem functions, but the visual aspect is often decisive, leading to the introduction of exotic species into urban landscapes for their aesthetic benefits as well as benefits to the human population [1]. Historically, in landscape architecture, ornamental plants with pronounced decorative traits were the most common choice for designing and greening urban areas [2,3]. Exotic species were once a symbol of prestige, with evergreen taxa dominating due to their year-round visual impact [3]. The

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aesthetic quality of green spaces and landscape attractiveness draws more user attention, encourages longer visitor stays, and contributes positively to mental well-being. In this context, the morphological appearance of plants is a key element in design [4], as aesthetics evoke positive impressions and influence human psyche and well-being. Plant diversity, habit, ornamental features, colours, and seasonal changes create striking visual effects [5]. Human vision is particularly stimulated by the use of varied colours, which evoke different emotions [6]. Regarding ornamental plant elements, the most prominent features are rich colours, diverse forms, and distinct textures [5].

Due to the significant role of exotic ornamental plants in landscape design, the aim of this study is to investigate the newly recorded taxon *Pyracantha angustifolia* (Franch.) C.K. Schneid. in Belgrade, providing new insights into the morphological traits and adaptability of this introduced shrub.

MATERIALS AND METHODS

In this study, a newly recorded taxon for the dendroflora of Belgrade, *Pyracantha angustifolia* (Franch.) C.K. Schneid. (narrowleaf firethorn), was analysed at Bežanijska Kosa, Samarska Street No. 8, where a border formed by five individuals of narrowleaf firethorn was documented. The location was georeferenced at coordinates 44°49'30.18" N and 20°23'1.04" E, at an altitude of 95 m. The border has a height of 118 cm and a length of 5.8 m (Figure 1).



Figure 1 Analysed border formed by *P. angustifolia*: a) and its visual aspects during; b) full flowering; and c) full fruit ripeness

The individuals are 10 years old, planted in spring 2015 during the reconstruction of the green area (data obtained from an interview with the property owner, on whose land the border is located). The study included measurements of height and length (using a tape measure). Flowering and fruiting abundance were assessed following Stilinović [7], along with decorative value and vitality. These parameters were evaluated on a scale of 1 to 5, where 1 represents <20% abundance, low aesthetic value, or poor vitality, and 5 represents

>90% abundance, high aesthetic quality, or strong vitality. In May 2025, during full flowering, inflorescences and fully mature leaves were collected and measured, while fruits were harvested at ripening at the end of summer in September. For morphometric analyses, 30 samples of each element were collected from the southern part of the canopy. Leaf length and width, two diameters of the inflorescence, number of flowers per inflorescence, largest diameter of individual flowers, number of stamens, and fruit diameter were measured. All measurements were taken using high-precision electronic calipers (± 0.001 mm). The number of fruits per cluster and the number of seeds per fruit were also recorded. Leaf, flower, and fruit colours were defined using the RGB (Red/Green/Blue) colour system.

Quantitative morphological data were analysed using descriptive statistics in XLSTAT 2020, while the Spearman rank test was performed using the SRplot statistical program [8].

RESULTS AND DISCUSSION

The family *Rosaceae* Juss. comprises 104 genera, including the genus *Pyracantha* M. Roem. Within the genus *Pyracantha*, which belongs to the subfamily *Amygdaloideae* Arn., tribe *Maleae* Small, and subtribe *Malinae* Reveal, there are six accepted species [9]. One of these is *Pyracantha angustifolia* (Franch.) C.K. Schneid. *P. angustifolia* is an evergreen shrub (rarely a small tree) that reaches a height of 2 to 4 (5) m and a spread of up to 5 m [10]. The branches are vertically oriented; when young they are densely covered with greyish-white hairs, later becoming dark grey or reddish-brown. Sharp thorns up to 2 cm long are present on the branches. The plant tolerates pruning well and is therefore suitable for forming hedges and borders. The leaves are simple, arranged spirally or in clusters. They are 2–7 cm long and 5–13 mm wide. The leaf margin is entire and recurved. The upper surface is dark green and glossy, while the underside is densely covered with white hairs. The leaves are borne on petioles 1–3 mm long [11,12]. The flowers are white, with around 30 flowers grouped in inflorescences. Individual flowers are 8–12 mm in diameter, with five sepals and approximately 20 stamens [13]. The flowering period lasts from April to June. The fruits are pome-type, round to slightly flattened, and small, measuring 5–9 mm in diameter. At maturity, they turn yellow or orange. Each fruit contains 3–6 seeds. The fruits are not edible for humans, as they contain hydrogen cyanide [12,14–17].

The mean scores for vitality and ornamental value were 4.8 and 4.6, respectively. Leaf length ranged from 44 mm to 62 mm, while leaf width ranged from 7 mm to 11 mm (Figure 2a). The maximum recorded leaf length was 10 mm greater than that reported in the literature (10–50 mm), whereas the leaf width fell within the reported range of 4–12 mm [13]. The diameter of the inflorescences ranged from 15 to 35 mm. The number of flowers per inflorescence varied between 5 and 22, while the diameter of individual flowers ranged from 5 to 10 mm (Figure 2b). The number of stamens ranged from 12 to 20 (Table 1). According to the literature, inflorescences contain up to 30 flowers, measure 20–40 mm in diameter, individual flowers are 5–12 mm in diameter, and flowers contain up to 20 stamens [12,13], which is consistent with our findings. Fruit diameter ranged from 3 to 7 mm (Figure 2c), which is also in agreement with the data reported by Chari *et al.* [13].

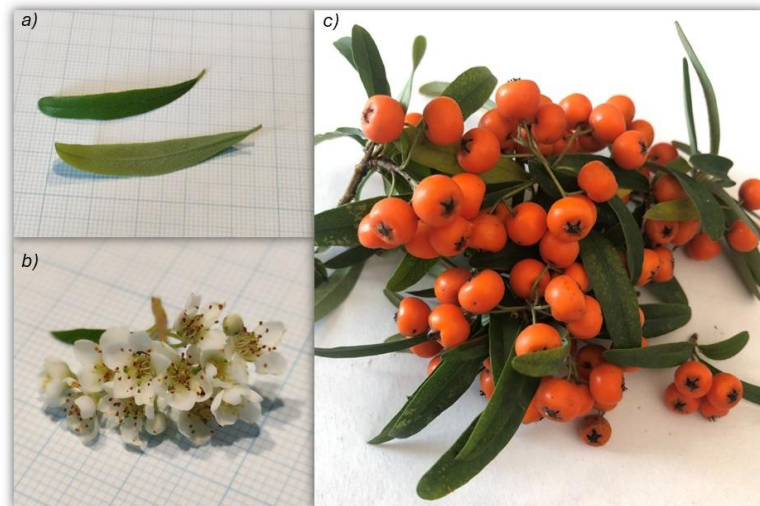


Figure 2 Analysed morphological parameters of *P. angustifolia*: (a) leaves, (b) flowers and inflorescences, and (c) fruits

By applying descriptive statistics, ranges as well as standard deviations and coefficients of variation were determined (Table 1).

Table 1 Descriptive statistics of morphological parameters of the taxon *P. angustifolia*

Character	N	Mean	Min	Max	Std	CV
Leaf length (cm)	30	5.54	44	62	0.520	9.385
Leaf width (cm)	30	0.89	7	11	0.122	13.808
No of flowers	30	12.8	5	22	3.969	31.007
Corymb radius (mm)	30	27	15	35	5.031	18.633
Flower radius (mm)	30	7.90	5	10	1.446	18.294
No of stamens	30	15.23	12	20	2.112	13.865
Fruit group radius 1	30	29.57	23	41	5.65	19.13
Fruit group radius 2	30	24.17	16	33	4.84	20.01
No of pomes	30	16.57	9	28	4.99	30.147
Pome radius	30	4.73	3	7	0.91	19.17
Seed	30	5	5	5	0	0

The standard deviations for leaf length and width were low (0.520 and 0.122), while the coefficients of variation (9.385 and 13.808) indicate low variability in leaf size. Spearman's rank correlation coefficient, at a significance level of $p < 0.05$, between leaflet length and width confirmed a negative correlation (-0.44), indicating that leaflet width decreases as its length increases (Figure 3a). The adaxial leaf surface was determined to be dark green (RGB 90/130/93), while the abaxial surface was grey-green (RGB 120/126/56). The appearance, colour, and size of flowers are highly important for design and aesthetics in landscape architecture; therefore, the visual characteristics of both inflorescences and flowers were also assessed. The colour of the petals was estimated as waxy white (RGB 222/212/200). Flowering abundance was rated as maximal (5). Moderate variability is indicated by the mean coefficients of variation (18.633, 18.294, and 13.865) for inflorescence diameter, flower

diameter, and number of stamens, respectively, whereas variability was high for the number of flowers per inflorescence, with a coefficient of variation of 31.007. Spearman's rank correlation coefficient, at $p < 0.05$, between inflorescence diameter and number of flowers (0.37), as well as between flower diameter within the inflorescence and number of stamens (0.81), indicates positive correlations (Figures 3b and 3c), while other correlations were not significant.

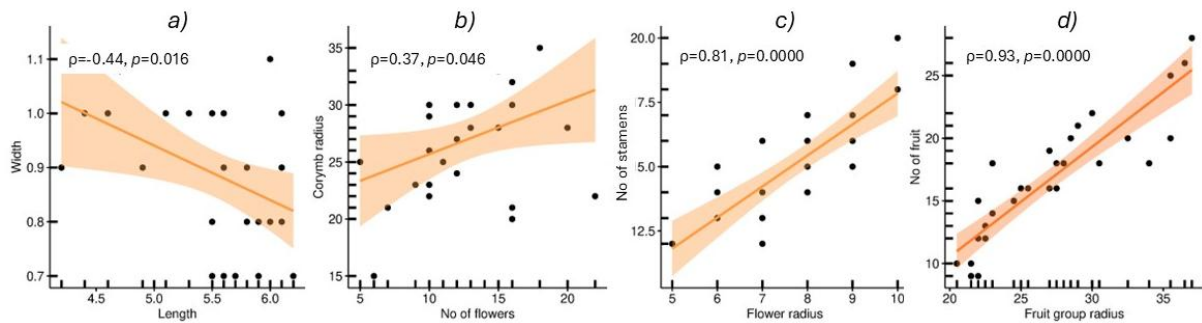


Figure 3 Scatter plots for Spearman's rank correlation: a) leaf length and width; b) number of flowers and corymb radius; c) flower radius and number of stamens; and d) fruit group radius group and the number of fruits. The shaded area represents the 95% confidence interval

Fruit yield was maximal (score 5). Each fruit contained five seeds, as also reported by Adams *et al.* [12], indicating high seed production. The pomes were described as round to slightly flattened, in orange-red to orange-yellow shades ranging from RGB 213/92/52 to 252/149/80. A standard deviation of 4.99 and a high coefficient of variation (30.147) for the number of fruits per cluster indicate greater variability, consistent with the analysis of the number of flowers per inflorescence. Spearman's rank correlation coefficients, at a significance level of $p < 0.05$, were statistically significant only for the mean diameter of the fruit cluster and the number of fruits (0.93), whereas no significant correlations were found for the other analysed fruit parameters (Figure 3d).

The results of this study indicate good adaptability and excellent condition of the analysed taxon, as also noted by Adams *et al.* [12], who highlight *P. angustifolia* as highly resilient. The taxon tolerates both high and low temperatures, as well as humid and dry conditions, partial shade, wind, soil salinity, and nutrient-poor soils [10–12]. Indicators of successful acclimatisation include all analysed morphological parameters, as well as maximal flowering abundance and excellent fruit production. In Europe, the species has become naturalised in Russia, Italy, Portugal, and Germany; however, it is classified as an invasive species and its use is prohibited in Australia [18]. During the study, the presence of *Passer domesticus* L. (house sparrow) was recorded within the analysed border, indicating that narrowleaf firethorn serves both as a habitat and a food source for this urban bird species, which inhabits densely branched shrubs that are becoming increasingly scarce due to urbanization [19]. The house sparrow plays an important role in maintaining biodiversity and controlling insect populations through urban food chains [20]. However, since *P. angustifolia* is easily dispersed and spread by birds [21] and exhibits invasive characteristics, it is necessary to continue monitoring its dispersal and potential further spread. Monitoring of this taxon is particularly important given

the presence of large areas of unmanaged land in the vicinity of the site where narrowleaf firethorn was recorded.

CONCLUSION

Our study provides important data in the form of a quantitative overview of the morphological characteristics of a newly recorded taxon in Belgrade. The highly ornamental evergreen taxon *P. angustifolia*, characterised by dark green leaves with a distinctive grey-green hue, abundant ornamental white inflorescences, and bright orange pome fruits, may represent a valuable new element in plant design within the urban landscape, particularly for borders and hedges. In addition to ornamental value, recent trends increasingly favour the cultivation of taxa that are resistant to climate change and exhibit rapid growth. The studied taxon, besides its morphometric characteristics, has also demonstrated excellent vitality, qualifying it as a highly resilient shrub suitable for use in the design of green spaces under urban environmental conditions.

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