

FLOWERING OF *Asimina triloba* (L.) DUNAL IN THE CONDITIONS OF TRANSYLVANIA

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Abstract. The *Asimina triloba* plant, of exotic origin, is the only species belonging to the arboreal fam. Annonaceae that is prevalent in temperate climates. Currently, *Asimina triloba* L. is appreciated both in North America and Europe primarily as a fruit tree species. Wishing to approach it as an ornamental plant, this paper includes phenological and morphological results of observations conducted on flowers of the *Asimina triloba* tree in Transylvania. In this regard, we determined the characteristics of decorative flowers, the stages of flowering and the time period for this process. We also established the number of flowers formed on the tree, as well as their morphology.

Keywords: asimina, phenology, floral morphology, ornamental species.

Rezumat. Înflorirea la *Asimina triloba* (L.) Dunal în condițiile din Transilvania. Planta *Asimina triloba*, de proveniență exotică, este singura specie arboricolă aparținând fam. Annonaceae, cu răspândire în climatul temperat. La ora actuală, specia *Asimina triloba* L., este apreciată atât în America de Nord, cât și în Europa cu precădere ca specie pomicolă. În dorința abordării plantei din perspectiva ornamentală, lucrarea de față, reprezintă ansamblul rezultatelor din observațiile fenologice și morfologice întreprinse asupra florilor arborelui de *Asimina triloba* din Transilvania. În acest sens, s-au determinat caracterele decorative ale florilor, fazele înfloriturii și perioada desfășurării acesteia. De asemenea s-a stabilit numărul florilor care s-au format pe arbore, precum și caracterele morfologice ale acestora.

Cuvinte cheie: asimina, fenologie, morfologia florală, specie ornamentală.

INTRODUCTION

Green areas represent the environment in which human life patterns correlate with natural or artificial elements thereof (SIMONDS, 1967), which fosters a sentiment for social, intellectual, emotional and emotive living. The nature of the urban environment, considered the widest and complex sphere of landscape architecture, comprises an inextricable intertwining between science and the art of green spaces (SZILAGYI et al., 2015).

Ornamental plants, a fundamental element of landscaping, form the main component of green spaces. In our country, the management of green spaces requires continuous improvement. In this context, the introduction of new decorative species is envisaged. We acknowledge that in our country, the interest for *A. triloba* is becoming more pronounced, making studies for its expansion to be increasingly deepened (SZILAGYI, 2015).

At present, *A. triloba* (L.) Dunal can be found in numerous botanical and private gardens in Italy and other European countries (SZILAGYI et al., 2015).

In Romania, *A. triloba* was first encountered as scattered fruit trees almost 50 years ago in the commune of Pianu de Sus (Alba County) (CEPOIU et al., 2004). Currently, in Romania, much research into the acclimatization of this tree species is ongoing, thanks to its landscaping and fruit potential (MIHĂILĂ et al., 2010; STĂNICĂ, 2012). A collection of several varieties of *Asimina* sp. is held by the Faculty of Horticulture at U.S.A.M.V. București. Two other collections are in private gardens in the county of Argeș and Ilfov (STĂNICĂ, 2012).

The *Asimina* tree is deciduous, growing from 5 m to 10 m in height, but it also can develop as an ornamental plant bush. The value of *A. triloba*, lies in its shape (SZILAGYI, 2015): it has a natural tendency to create a crown-shaped pyramid in sunny places with dense foliage, with a straight trunk full of sap. It can also be globular, in which case it develops many lateral branches, which gives it the aspect of a typical chandelier [ARITON (DĂNĂILĂ-GUIDEA), 2005]. In the forests of different areas of the US, *Asimina* trees often grow in clusters or thickets that can result in root suckers or as a result of germination of seeds from the fruit fallen from the tree planted previously. The crown is dense, ornamental in type, and trees form a pyramidal crown. In the shade, pawpaw form a larger crown with few low branches and leaves arranged horizontally. The trunk is smooth, generally straight, with dark brown bark. The decor is enhanced by the coppery colour of the plant flowers that evolves into shades of dark purple, appearing in early spring before the leaves (SZILAGYI, 2015).

According to the assessments made by LAYNE (1996) and POMPER & LAYNE (2005), the appearance of this ornamental tree recommends *A. triloba* as an "integral component of the landscape aesthetic." Thus, *A. triloba* is a tree with high commercial potential highlighted by its ornamental qualities (SARGENT, 1890).

Taking into account the assessments of the researchers mentioned above, we believe that efforts to introduce *A. triloba* into the green areas of Romania are justified due to its ornamental characteristics and its relatively easy adaptation to the environmental conditions in our country, as well as the strength of its resistance to diseases and pests (SZILAGYI, 2015). This study takes into account the phenological and morphological observations taken on flowers of the *A. triloba* tree on specimens in Transylvania.

MATERIAL AND METHODS


In the spring of 2016, we made a series of observations and measurements on the flowers of 15 plants, which are 5-year-old *A. triloba* specimens in Transylvania. On every tree, 30 flowers were monitored in order to establish the stages of flowering and their morphological characteristics in the conditions of the northern part of Romania. To establish criteria for assessing the decorative characteristics of the anthesis, we established an arrangement of petals inside and outside of the flowers, the form of the androecium and the number of carpels that form the 15 plants analysed. Using digital calipers, we determined the length of the petals and the diameter of the androecium.

In order to obtain morphometric measurements of the number of branches of the plant, the number of flowers formed thereon and to determine their diameter and height, we took observations and measurements based on tree exposure to direct sunlight, diffused sunlight and shade. To establish the influence of light on *A. triloba* plants, we organized a single-factor experiment involving five plants with one variation, namely: V₁-plants exposed to direct sunlight (Mt.); V₂-plants exposed to diffuse sunlight, V₃-shade plants. The results are shown in table form.

RESULTS

In the spring of 2016, we made a series of observations and measurements on the flowers of 15 plants, which are *Asimina triloba* specimens aged 5 years in Transylvania. We monitored 30 flowers / *A. triloba* tree in order to establish the stages of flowering and morphological characteristics of their conditions in the north of the country. The results presented in Table 1 show the assessment criteria for anthesis in 2016 in Transylvania.

Table 1. Evaluation criteria for *A. triloba* by flowers in the conditions of Transylvania.

No.	Decorative character of the anthesis		Evaluation criteria	<i>Asimina triloba</i> flower
1	Calyx (sepal)		Double sepal with free member sepals stuck to the corolla	
2	Corolla (petal)	Layout of inner petals	Female: petals oriented erect Male: stamen petals are removed	
		Layout of outer petals	They are free, equal in size and decorative shade: carmine red	
		Length inner petals	Size between 5.95 mm and 11.21 mm average value of 8.50 mm	
		Length outer petals	Size between 12-14 mm and 24.29 mm with a mean of 18.27 mm	
3	Androecium (stamen)		Globular-shaped stamen with a diameter ranging between 6.27 mm and 8.60 mm, and a mean of 7.74 mm	
4	Gynoecium (number rags)		3-9 in pieces	

Analyzing the results in Table 1 reveals that the average value is 8.50 mm for the inner petals, and for the exterior 18.27 mm, the androecium has an average value of 7.74 mm, while the gynoecium has between 3 and 9 carpels formed.

The flowers of *Asimina triloba* are the chief element of this ornamental plant. The ornamental effect of its flowers is enhanced by their coppery hue, decorating the beginning of spring, before leaf formation (Fig. 1).



Figure 1. Different phases of flowering and branch positioning on *Asimina triloba* (Original photo-copies from a private collection-Baia Mare).

The following are the flowering stages for *Asimina triloba* in Transylvania, we present the unfolding period and its duration in days (Table 2).

Table 2. Dynamics of flowering phases of *A. triloba* in the conditions in Transylvania.

No.	Phase	The cumulative time in days (1-28)	Period (April 7 -May 5)
1	Phase floral button	X X X	April 7-9
2	Opening of flower	X X X X X X X X X X X X X X X X	April 10-25
3	Pistil formation (gynoecium)	X X X X X X X X X X	April 18-27
4	Opening stamen (androecium)	X X X X X X X X X X X X X X X X	April 18, May 2
5	Fall of corolla	X X X	May 3-5

Following the observations made, it was noted that the beginning of the vegetation period of the flowers is marked by the button phase and lasts three days (April 7). Regarding the ornamental potential of the flowers, it is given by floral decoration that displays itself until the fall of the corolla, which in 2016 lasted 24 days. The end of the floral decoration is marked by the fall of the corolla (Table 2).

To determine the size of the plant branches on *A. triloba*, we measured the same number of branches (75) for each variant (see Table 3).

Table 3. Morphometric determinations on *A. triloba* plant branches existing in temperate climate (Baia Mare).

No.	Variant	Number of analysed branches	Dimensions of branches (cm)		
			Minimum	Maximum	Average
1	V ₁ - plants exposed to direct sunlight (Mt.)	75	9,8	116,0	61,9
2	V ₂ - plants exposed to diffuse sunlight	75	12,5	138,0	57,3
3	V ₃ - plants with shade exposure	75	6,7	90,0	52,3

Analyzing the results shown in Table 3, we found that the size of the smallest branches, in plants exposed to shade, is between 6.7 and 90 cm. More developed branches were recorded for *A. triloba* plants exposed to diffuse sunlight, with values between 12.5 and 138 cm.

In order to introduce *A. triloba* among the ornamental plants of Transylvania, we determined the number of flowers per branch formed under different conditions of light exposure (Table 4).

Table 4. Morphometric determinations of the number of flowers formed on *A. triloba* plant branches.

No.	Variant	Number of analysed branches		
		Minimum	Maximum	Total flowers formed on tree
1	V ₁ - plants exposed to direct sunlight (Mt.)	1	22	116
2	V ₂ - plants exposed to diffuse sunlight	2	34	191
3	V ₃ - plants with shade exposure	1	15	101

The number of flowers formed on the tree in the analysed period (spring 2016) varied between 101 and 191, while the maximum recorded number of flowers on a branch was 34.

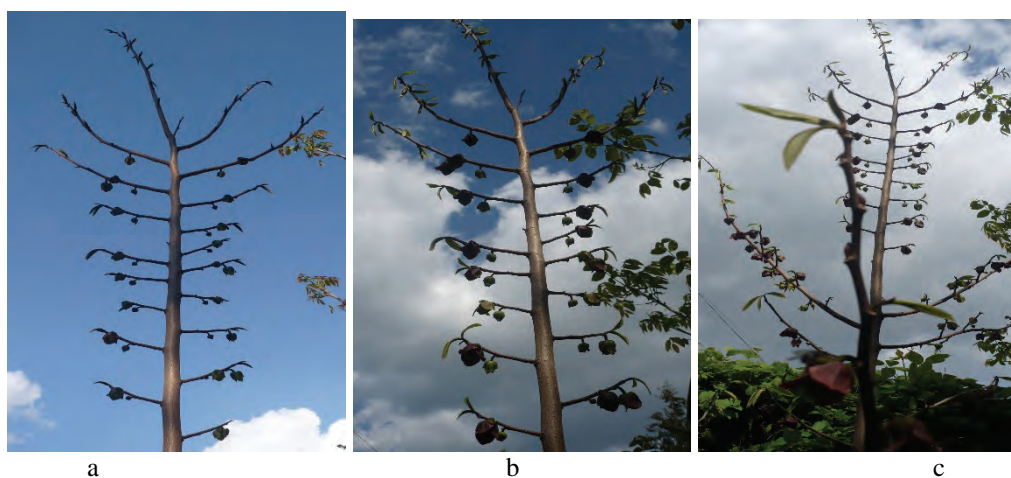


Figure 2. Stages of growth, development and formation of *A. triloba* flowers on branches (Original photo-copies from a private collection-Baia Mare).

Likewise, in 2016, we determined diameter and length of *Asimina triloba* flowers on trees grown in different light intensities (Table 5).

Table 5. Morphological characteristics of *A. triloba* flowers.

No.	Variant	Analysed number of tree flowers	Analysed decorative characteristic (mm)			
			Min.	Max.	Med.	Flower <i>Asimina triloba</i>
1	V ₁ - plants exposed to direct sunlight (Mt.)	30	24.37	38.36	30.51	Diameter of flower
2	V ₂ - plants exposed to diffuse sunlight	30	27.42	33.47	30.52	
3	V ₃ - plants with shade exposure	30	18.58	32.23	25.62	
4	V ₁ - plants exposed to direct sunlight (Mt.)	30	15.95	22.71	19.64	Length of flower
5	V ₂ - plants exposed to diffuse sunlight	30	18.31	22.93	20.90	
6	V ₃ - plants with shade exposure	30	15.24	22.54	19.30	

The results showed that in the north of Romania *A. triloba* flower diameter is between 18.58 mm (V₃ - plants with shade exposure) and 38.36 mm (V₁ - plants with exposure to direct sunlight) and that the length of flowers varies between 15.24 and 22.93 mm.

DISCUSSIONS

The studied *Asimina triloba* plants were exposed to natural conditions in Baia Mare. Table 6 shows the climate conditions in Baia Mare under which the flowering of *A. triloba* took place this year.

Table 6. Climatic conditions recorded at Baia Mare during blooming period (April 7,-May 5).

Period	Average temperature (°C)	Maximum temperature (°C)	Minimum temperature (°C)	Atmospheric pressure (hPa)	Air relative humidity (%)	Rainfall amount (mm)	Wind speed (km/h)
7.04-5.05	13.5	19.34	7.54	1,012.32	71.58	1.58	33.12

Also In the period under review (April 7-May 5), it was also determined sunrise and sunset time and azimuth (where the sun rises and where the sun sets) thereof (Table 7). The mean value recorded in Table 7 corresponds to *A. triloba* flowering period for which research reports were made in this paper.

Table 7. Moment of sunrise and sunset during the blooming period of *A. triloba* (April 7, May 5).

Location	Geographic coordinates	Period	Sunrise		Sunset	
			Hours	Azimuth (°)	Hours	Azimuth (°)
Baia Mare	Latitude 47°40' N Longitude 23°35' E	April 7-May 5	6.25	71.20	20.24	289.08

CONCLUSIONS

Our studies have shown that the *Asimina triloba* plant lends itself to partial sun exposure, so we recommend planting it in semi-shade in green spaces in Transylvania. The results obtained from the morphological measurements of the variations highlighted the growth in length of branches (52.3 cm and, respectively, 61.9 cm for plants in V₃ and plants in V₁-Mt) and of the number of flowers formed on trees due to their positioning in light of different intensities. Differences were found in the values of length and floral diameter. Based on the results, we recommend introducing *A. triloba* into the range of ornamental plants in Transylvania.

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