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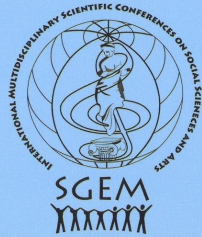
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THE EXTERNAL DEFECTS AND THE PARTICULARITIES OF THE TREES CROWNS LOCATED INTO THE GREEN AREAS OF BRAȘOV

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ABSTRACT

The analysis of the defects detected at the standing trees, located into localities, is very important because in this way it can highlight potential risk at the mature trees, especially at those who are isolated and whose growth is influenced to a large extent by human intervention. Besides the indisputable beneficial effects of the trees, a green areas indispensable component of the localities, they, after a certain stage of development, may present a very high potentially of risk in areas where they are located. Potential level of risk is given in a largely of morphological features of trees reached adulthood.

Based on this finding the authors have proposed to highlight some features of the defects and to study the asymmetry of the crowns for the trees located on streets, in the Brașov city. In the conducted research was included a batch of 259 trees of next species: common linden (*Tilia cordata* Mill.), Norway maple (*Acer platanoides* L.), sycamore (*Acer pseudoplatanus* L.) and horse chestnut (*Aesculus hippocastanum* L.).

From the results of the research it must be specified that the highest frequency of curvatures and knots appears at *Acer pseudoplatanus*, and the highest frequency for ovality, forking, hollows and frost-crack at *Acer platanoides*.

Regarding the crown asymmetry it was found that the ratio between the maximum radii length and minimum radii length of a tree is between 3.68 and 9.57. This aspect associated with the greater values of standard deviations, in many cases greater than 40% , leads to the conclusion that this parameter should be analyzed by taking into account other influencing factors.

Keywords: defects of the trees, asymmetry of the crown, the radii of the crown.

INTRODUCTION

The trees presence in public areas is very important because they influence positively the human life and contribute to a pleasant and healthy environment. The functions that must meet the trees located into the public areas depend, to a large extent, on the quality and the permanence of the trees.

The green areas of cities have ornamental role, but at least as much, are designed to improve the characteristics of urban ecosystems were are placed [8].

The green area of cities consists in trees in a large part. Due of their dendrometric characteristics they become an integral part of urban design [10]. The disadvantage consists in a high potential of the accident, because after a certain stage of development, due to the development conditions and physiological features, the trees are likely at breaking or uprooting. One of the most important cause leading to this situation is the presence, the frequency and the intensity of the defects which occurring in mature trees.

In this respect, the authors have proposed to analyze the defects frequency in standing trees placed on the streets of Braşov city. Were analyzed defects such as: curvature, forking, knots, frost-cracks, hollows, to which was added the asymmetry of crown. This latter feature was considered given the strong influence of the asymmetry of crowns on the stability at mature trees.

Study area

The Braşov city is located in the curvature zone of the Carpathian Mountains, respectively at the contact between the Eastern Carpathians and Southern Carpathians, in the Braşov Depression, Bârsa compartment [9] at north latitude of 45°38' and east longitude 25°35'. Located on a geological substrate consisted of silt superimposed on a limestone layer, at an mean altitude of 625m, the climate is temperate continental with an annual average temperature of 7.60C, precipitation regime 600 ... 700 mm/year and annual average humidity of 75% [1]. The dominant winds acting on the directions west and north-west with average speeds between 1.5 and 3.2m/s.

The analyzed trees are placed individually on the streets of the city, targeted dominant at north-west direction. The buildings that bordering the streets have in the most part, heights less than 8 m.

Research methodology

In the conducted research 259 trees were analyzed. For each of these were recorded: the species, the biometric characteristics (the base diameter and height), the type, number, position and size of the defects, the length of the horizontal projection for the four radii of the crown, considered on the cardinal directions north, east, south and west. The lengths of the radii were measured from the centre of the trunk base.

Measurements were performed with: the forester calliper for the base diameter, the roulette for measuring the size of defects detected at a height less than 2m and for the length of horizontal projection of rays crowns, the device Criterion RD 1000 for measuring the dimensions of defects located at heights greater than 2m; the device TruPulse 200 TM for measuring heights, compass for the cardinal directions and the Pressler drill.

The base diameters were measured on two directions: the maximum diameter and the diameter perpendicular to it. The knots were considered according the morphological features [2], [5], [7] and for forking was used the methodology proposed by Câmpu [4].

Result and discussions

In the conducted research were analyzed the following tree species: common linden (*Tilia cordata* Mill.), Norway maple (*Acer platanoides* L.), sycamore (*Acer pseudoplatanus* L.), horse chestnut (*Aesculus hippocastanum* L.), whose main characteristics are shown in Table 1. The base diameters range between 41.10cm and 54.29cm, and the heights from 13.16m to 17.56m. The age of trees was approximated by measuring the width of annual rings on the cores extracted with Pressler drill. It was assessed that the trees age from the analyzed group is between 70 and 80 years.

Table 1. The biometrical characteristics of the analyzed trees

Species	The number of analyzed trees	Biometrical characteristics:	
		base diameter [cm]	height [m]
<i>Tilia cordata</i>	61	53.76	14.52
<i>Acer platanoides</i>	21	41.10	13.16
<i>Acer pseudoplatanus</i>	14	54.29	17.56
<i>Aesculus hippocastanum</i>	163	42.29	16.92

The characteristics of the analyzed defects are presented in Tables 2 ... 8.

Data on curvature (Table 2) shows that this defect occurs most frequently at *Acer pseudoplatanus* (53.22%), the minimum value being recorded at *Tillia cordata* (26.22%). The curvatures were analyzed also in terms of their complexity, respectively proportion of the single and multiple curvatures. It is finds that the maximum values for the single and multiple curvatures are recorded at *Acer pseudoplatanus* (35.71% and 17.51%) and minimum values are meeting at *Tillia cordata* for simple curvature (18.62%) and *Acer platanoides* (5.71%) for multiple curvatures.

Table 2. The distribution of the trees with curvatures located on the trunk

Species	The proportion of trees with curvatures	The percentage repartition of the curvatures	
		simple	multiple
<i>Tilia cordata</i>	26.22	18.62	7.60
<i>Acer platanoides</i>	28.56	22.85	5.71
<i>Acer pseudoplatanus</i>	53.22	35.71	17.51
<i>Aesculus hippocastanum</i>	31.90	22.65	9.25

Another analyzed defect was ovality (Table 3). It finds that all the trees of *Acer pseudoplatanus* present this defect, while 9.23% of the trees of *Acer platanoides* do not have it. The percentage distribution on the ovality categories highlights that the maximum value (48.14%) is recorded between 5.1 – 10% at *Acer pseudoplatanus*. The

extreme values of the ovality, of over 20%, are recorded at *Aesculus hippocastanum*. In the other hand, at *Acer platanoides* was not recorded ovality greater than 15%.

Table 3. The distribution of trees with ovality

Species	The percentage distribution of trees with ovality [%]:					
	0	0.1 – 5	5.1 – 10	10.1 – 15	15.1 – 20	> 20
<i>Tilia cordata</i>	7.14	33.06	31.23	14.35	7.68	6.54
<i>Acer platanoides</i>	9.23	32.54	48.14	10.09	0	0
<i>Acer pseudoplatanus</i>	0	35.65	39.67	13.27	7.03	4.38
<i>Aesculus hippocastanum</i>	8.51	18.1	22.04	20.01	19.33	12.01

Regarding the forking it is found that generally more than half of the trees present this defect (Table 4). The highest frequency of the forking is found at *Aesculus hippocastanum* (74.84%) and the lowest at *Acer pseudoplatanus* (42.85%). Regarding the distribution of the forking on the height of trees, it can say that the defect appears dominant in the lower third of the trunk for all species. The maximum value is recorded at *Acer platanoides* (76.19%). *Aesculus hippocastanum* and *Tilia cordata* do not present forking in the upper third.

Table 4. The distribution of the forked trees according with the position of the defect

Species	The proportion of trees with forking	The proportion of trees with forking in the ... third the trees height			The proportion of forked trees according the number of branches			
		lower	middle	upper	2	3	4	5
<i>Tilia cordata</i>	55.73	47.54	8.19	0	40.96	6.55	4.91	3.31
<i>Acer platanoides</i>	85.71	76.19	4.76	4.76	66.66	19.05	0	0
<i>Acer pseudoplatanus</i>	42.85	28.57	7.14	7.14	35.71	7.14	0	0
<i>Aesculus hippocastanum</i>	74.84	67.48	7.36	0	57.05	5.06	12.06	0.67

Analysis of the number of branches of the forking (Table 4) show that the trees with two branches are the most frequent (between 35.71% and 66.66%), the extreme values are recorded at *Acer platanoides*, respectively *Acer pseudoplatanus*. At the same species are not recorded forking with 4 and 5 branches.

The knots, the defects with the largest spread in the trees, were analyzed both in terms of frequency, the number of knots per tree, and also by assigning them into categories [6]: hidden, covered, healthy, vicious and rotten (Table 5). This defect appears at all examined trees in a maximum average number of 34.47 knots/tree at *Aesculus hippocastanum* and a minimum average number of 18.32 knots/tree at *Acer platanoides*.

Table 5. The percentage distribution of knots

Species	Mean number of knots per tree	The percentage repartition of knots				
		hidden	covered	healthy	vicious	rotten
<i>Tilia cordata</i>	18.32	25.48	16.31	21.51	18.24	18.46
<i>Acer platanoides</i>	19.16	18.32	19.06	20.14	17.33	25.15
<i>Acer pseudoplatanus</i>	13.27	21.08	11.69	20.01	18.55	28.67
<i>Aesculus hippocastanum</i>	34.47	14.24	7.06	29.34	21.15	24.21

Percentage distribution of categories of knots shows that the maximum proportion appears at the healthy knots of *Aesculus hippocastanum* (29.34% of the total number of knots registered), and the minimum proportion (7.06%) at covered knots of the same species. The rotten knots, which particularly affect the stability of trees, occur in a large proportion at the trees examined, affecting about 18 ... 28% of them, regardless of species.

The tree stability is influenced in a large extent by the presence and size of hollows. As it can be seen from Table 6 this defect occurs in about half of the analyzed trees. Effectively, the maximum and minimum percentage of trees with hollows is 61.89% at *Acer platanoides* and 41.09% at *Aesculus hippocastanum*. It was analyzed also the percentage distribution of the number of hollows identified on a tree, ascertaining that the most common are situations with a single hollow detected on a tree, as is the case of the two species *Acer platanoides* (38.09%) and *Tilia cordata* (32.14%). The maximum number of hollows per tree was recorded at *Aesculus hippocastanum* (4 hollows per tree) to 4.91% of the analyzed trees.

Table 6. The distribution of hollows

Species	The proportion of trees with hollows	Percentage distribution of the number of hollows in a tree:			
		1	2	3	4
<i>Tilia cordata</i>	52.44	31.14	19.67	1.63	0
<i>Acer platanoides</i>	61.89	38.09	23.80	0	0
<i>Acer pseudoplatanus</i>	42.84	7.14	21.42	14.28	0
<i>Aesculus hippocastanum</i>	41.09	18.40	12.26	5.52	4.91

The frost-crack also affects all studied species in proportions between 52.37% at *Acer platanoides* and 24.51% at *Aesculus hippocastanum* (Table 7) of the total number of trees. The defect was analyzed taking into account five categories of its length [5]. It appears that the most frost-cracks have lengths less than 50 cm (28.57% at trees of *Acer platanoides*) and the lowest frequency (0.61%) is recorded at the species *Aesculus hippocastanum*. It should be noted that at *Acer pseudoplatanus* does not appear frost-cracks with lengths more than 100 cm.

Table 7. The repartition of frost-cracks

Species	The proportion of trees with frost-cracks	The percentage distribution of the frost-crack according with the length:				
		< 50	51-100	101-150	151-200	> 200
<i>Tilia cordata</i>	34.39	9.83	8.19	4.91	4.91	6.55
<i>Acer platanoides</i>	52.37	28.57	4.76	9.52	4.76	4.76
<i>Acer pseudoplatanus</i>	28.56	7.14	21.42	0	0	0
<i>Aesculus hippocastanum</i>	24.51	4.29	9.81	6.74	3.06	0.61

The asymmetry of the crown is a feature resulting from the need of the tree to grab the light required for photosynthesis process [11]. Effectively, this process is manifested by the ability of the trees to develop in lateral their crown – phenomenon known as the plasticity of crown [3]. Other important factors that influence the asymmetry of the crown are: the species, the dominant position of the light source, the direction of prevailing winds, the physiological and morphological features, the action of phytopathogens agents etc. This feature was analyzed because it affects in a large extent the stability of the trees subjected to wind action.

This feature of the trees was analyzed by measuring the horizontal projection of the crowns on the ground. The measurements were made from the centre of the trunk on the four cardinal directions. The mean lengths of rays are shown in Table 8. It can be seen that these values are between 2.75 m at *Tilia cordata* in the north and 4.99 m on the same direction for *Acer pseudoplatanus*.

Table 8. The values of the horizontal projections of the rays crowns

Species	The horizontal length of rays on cardinal directions [m]				The percentage differences between the crowns rays. Maximum ratio (Rmax / Rmin) between:	
	North	East	South	West	Middle rays	Measured rays
<i>Tilia cordata</i>	2.75	3.02	3.18	2.84	1.15	13.85
<i>Acer platanoides</i>	3.60	4.12	4.16	4.60	1.27	5.85
<i>Acer pseudoplatanus</i>	4.99	4.76	4.32	4.60	1.15	4.57
<i>Aesculus hippocastanum</i>	3.20	3.25	3.36	3.19	1.05	12.57

Statistical analysis of the data regarding the dimensions of the horizontal projection of the crown (Table 8) shows that the minimum values of the measured rays (0.7 m) are recorded at *Tilia cordata*, in the west cardinal direction, and *Aesculus hippocastanum* in east. For the same situation, the maximum value is registered at *Tilia cordata* (9.7m) on the East direction.

The analysis of homogeneity of values corresponding to the rays length, for the four cardinal directions, for the analyzed species, show that for *Acer platanoides* the

variation of the value, expressed by the standard deviation (Table 9), is minimal, and for *Acer pseudoplatanus* this value is maximal.

Expressed in percentage, the differences between the standard deviations in those two cases mentioned, is 1.11% and 106.16%. The values of the coefficient of variation between 23.65% and 43.27% confirms the representative ness of the calculated averages, indicating that some of them are at the limit of the confidence interval - values greater than 40%.

Table 9. Descriptive statistics of the lengths radius values

Species	Cardinal direction	Radius length [m]			Standard deviation	Coefficient of variance
		mean	minimum	maximum		
<i>Tilia cordata</i>	North	2.75	1.0	6.8	1.094	39.78
	East	3.02	0.8	9.7	1.304	43.17
	South	3.18	1.2	6.3	1.086	34.15
	West	2.84	0.7	5.9	1.202	42.32
<i>Acer platanoides</i>	North	3.60	1.6	5.9	1.325	36.80
	East	4.12	1.6	7.9	1.705	41.38
	South	4.16	2.4	8.0	1.617	38.87
	West	4.60	1.4	8.2	1.659	36.06
<i>Acer pseudoplatanus</i>	North	4.99	2.1	8.5	2.107	42.22
	East	4.76	2.3	9.6	2.060	43.27
	South	4.32	2.6	5.8	1.022	23.65
	West	4.60	2.6	8.3	2.016	43.82
<i>Aesculus hippocastanum</i>	North	3.20	0.9	8.4	1.215	37.96
	East	3.25	0.7	6.7	1.290	39.69
	South	3.36	0.8	8.8	1.361	40.50
	West	3.19	1.1	7.5	1.245	39.02

CONCLUSIONS

The researches has pointed out that the trees located in the city, along streets, which arrived at adulthood is characterized by a large number of defects which affect their stability. Among these should be mentioned in particular: the curvature and the knots identified at *Acer pseudoplatanus*; the ovality, the forking, the hollows and the frost-cracks at *Acer platanoides*.

Apparently, the crown asymmetry, expressed as mean values of the horizontal projections of the rays, is not a risk factor, but the analysis of the measured values of the rays shows that the ratio between the maximum and minimum lengths of the rays of a tree is between 3.68 and 9.57. This conclusion, coupled with standard deviation values greater than 40%, found in 7 of the 16 cases analyzed, and leads to the conclusion that this feature must be analyzed by taking into account other factors which influencing the crown asymmetry.

The frequency analysis of the defects identified at trees placed on the streets of urban centres is very important because it constitutes an essential step in assessing the potential risk which they may represent it. The result of the analysis can consist one of the most important elements in the management of forest vegetation from urban green areas. Based on this, it can set the risk coefficients and measures to reduce the potential

risk of the trees or it can decide to replace those trees whose condition no longer can be improved.

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THE IMPACT OF POLLUTED RIVER SITNICA IN FLORA AND VEGETATION AROUND THE RIVER

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ABSTRACT

During the year 2012-2013 we have investigated the vascular flora along the Stream of Sitnica River, in particular woody plants, bushes and Liana (Liane) that dominates and establish the associations of which most important are associations: *Salicetum Elbe fragilis* and *Salici -Populetum Nigeria*.

Sitnica River enters under a slow flow rivers and passes through the localities that are heavily influenced by the anthropogenic and industrial pollution. This river originates in the village Sazli and traverses about 90 km of the territory of Kosovo until the spill into the river Iber.

The purpose of this study has been the investigation of vascular flora along the river flow Sitnica, the impact of polluted river water in the flora and vegetation and the impact of these plants on environmental protection.

To investigate the impact of polluted river water Sitnica flora and vegetation that grows in the area attacked by contaminated water we have researched heavy metal accumulation of these plant species: *Typha angustifolia* L., *Urtica dioica* L., *Ranunculus sardous* Crantz., *Rumex Crispus* L. Plant species surveyed are taken during the vegetative stage, while heavy metal analysis is done in the laboratory. The method of attack against: Tackling was conducted in microwave with HNO₃ + H₂O₂ mixture in accordance with the instructions of the device manufacturer.

Keywords: Sitnica River, Pollution, *Typha angustifolia*, *Urtica dioica*, *Ranunculus sardous*, *Rumex Crispus*.

INTRODUCTION

Our studies have shown that along the river Sitnica dominate trees: *Salix Alba*, *Populus nigra* and *Populus canadensis*. From plant shrubs are present species: *Cornus Mas* and *Cornus Sanguinea*; while from the line are present species *Vitis vinifera* and *Clematis vitalba*. Of herbaceous plants dominate herbaceous perennial plants, but there are

