RESEARCH ON URBAN GREENERY OF REPRESENTATIVE TYPES IN THE AVENUES OF A BIG CITY

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1. INTRODUCTION

Urban greenery is of fundamental importance for the quality of life on our ever increasingly urbanized societies [1, 2]. More specifically, this term refers to open green spaces that are located in the urban web and which include parks, street trees and other garden areas [3, 4, 5].

The urban environment constitutes a difficult biotope for the trees. The environmental pressures decrease the vitality of many species and increase their sensitivity to diseases and parasitic attacks.

The aim of this study is to record the existing situation and to evaluate the trees of three representative types in the avenues chosen by their density of greenery, in the Municipality of Thessaloniki.

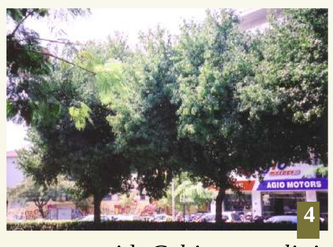


Figure 1. Street trees with *Platanus orientalis* in Nikis Avenue. ***Figure 2.*** Street trees with *Celtis australis* in Egnatia Street. ***Figure 3***. Street trees with *Albizia julibrissin* in Karamanli Avenue. ***Figure 4.*** Street trees with *Liquidambar orientalis Mill* in the central division of Karamanli Avenue.

Figure 5. Street trees with *Populus X euramericana cv. 'I-45/51'* in Karamanli Avenue.

The aim also included the formulation of proposals in order to make some improvement in the choice of species so as to increase the amount of green spaces in the city. More specifically the issues studied were:

- What problems do these trees face now and will face in the future?
- Do the characteristics of the trees influence the density of greenery?
- Is there a linear model to correlate the green volume indicator to the characteristics of the trees?

Figure 6. Street trees with *Cupressus arizonica* in the central division of Karamanli Avenue.

2. MATERIALS AND METHODS

The research took place in the region of the Municipality of Thessaloniki, which is located in North Greece. The research included the study of the trees along three central roads of the city, which are a) Nikis Avenue b) Egnatia Street and c) Karamanli Avenue.

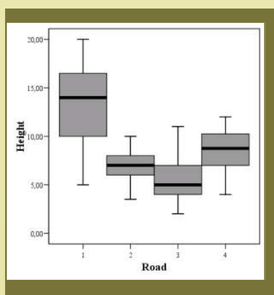
These three avenues of trees were chosen in order to study the condition and to evaluate the behaviour of the species *Platanus orientalis* (Nikis Avenue), *Celtis australis* (Egnatia Street), *Albizia julibrissin* (Karamanli Avenue), *Liquidambar orientalis* Mill. (Karamanli Avenue), *Cupressus arizonica* Green (Karamanli Avenue) and the clone *Populus X euramericana cv. 'I-45/51'* (Karamanli Avenue) in correlation to the green surface that they occupy in the three representative roads of the city. In each road, sample trees were measured for height, height of the start of the crown, breast diameter and crown dimensions. All the measurements were computer registered with the use of statistical package of SPSS version 12.0 for Windows.

The crown shape of each tree was recorded, its general situation and any damage presented. The recording of the damages was done according to a specific damage diagnosis catalogue[6]. Moreover, for each road the green surface indicator (the active green surface of the crowns divided by the length of the road) and the green volume indicator (active green volume of the crowns divided by the length of the road) were calculated. With regard to the relationship between the green surface indicator and the tree characteristics, a linear model was estimated using the multivariate regression analysis.

3. RESULTS

A brief presentation using box and whisker plots of the results of the statistic processing of the tree height values and tree diameter values in the studied roads is given in Figure 7 (1. Nikis Avenue, 2. Egnatia Street, 3. Karamanli Avenue, 4. Central division of Karamanli Avenue). In Figure 8 there is a corresponding presentation of the tree height values and tree diameter values of the studied silvicultural species (1. *Platanus orientalis*, 2. *Celtis australis*, 3. *Albizia julibrissin*, 4. *Liquidambar orientalis* Mill., 5. *Cupressus arizonica* Green, *6. Populus X euramericana cv. 'I-45/51')*.

The box-and-whisker plot shows a graphic presentation of information on the distribution of data that are examined. The values of inferior and superior percentile (25^{th} and 75^{th} percentile) determine the beginning and the end of the box-and-whisker plot, which contains the intermediate 50% of prices of data. The horizontal line that cuts the box-and-whisker plot depicts the median.



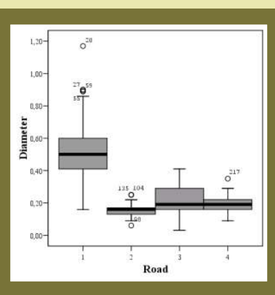
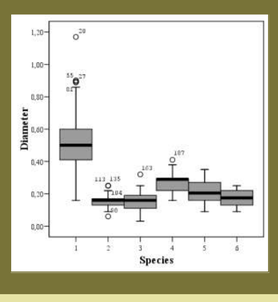


Figure 7.
Box-and-whisker plots of height and breast diameter of the three central roads and the central division



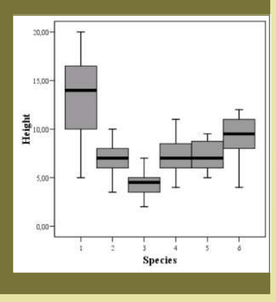


Figure 8.
Box-and-whisker plots of height and breast diameter of the six silvicultural species

According to Figure 7, the distribution of height data is normal in Egnatia Street (road 2) while the corresponding of breast diameter data is normal in Nikis Avenue (road 1) and in the central division of Karamanli Avenue (road 4). According to Figure 8, the distribution of height data is normal in the species Celtis australis (species 2) and Populus X euramericana cv. 'I-45/51' (species 6) while the corresponding of breast diameter data is normal in the species Platanus orientalis (species 1), Cupressus arizonica Green (species 5) and Populus X euramericana cv. 'I-45/51' (species 6).

Figure 9. Bark damage in the species *Celtis australis.*
Figure 10. Intensive pruning of the species *Albizia julibrissin.*

Figure 11. Bark damage in the species *Albizia julibrissin.*
Figure 12. Inadequate root space depth *(Populus X euramericana cv. 'I-45/51').*

Figure 13. Insect and fungi attacks on the leaves of *Platanus orientalis.*

Figure 14. Crowns of *Platanus orientalis* touching each other.

The problems that the trees of each species faced are presented in Figures 15, 16, 17, 18, 19, 20 (1. Drying out of the crown, 2. Insect and fungal damage, 3. Ivy on trunk, 4. Tree too close to road, 5. Long crown depth close to asphalt surface, 6. Crown width over road, 7. Tree too close to buildings, 8. Crowns touching each other, 9. Crowns touching buildings, 10. Damage from construction, 11. Trees too close to cables or light source, 12. Inadequate root space depth, 13. Compaction of soil, 14. Soil removal, 15. root damage due to construction work, 16. Pavement damage due to roots, 17. Root damage, 18. Fluid secretion on trunk, 19. Bark damage, 20. Tree decay, 21. Narrow bi-furcation, 22. Water retention in bi-furcation, 23. Dry and broken branches, 24. Spreading branches, 25. Branch tufts due to pruning, 26. Intensive pruning).

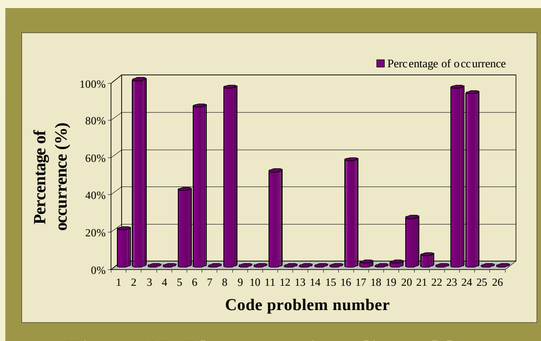


***Figure 15. Platanus orientalis* problems**

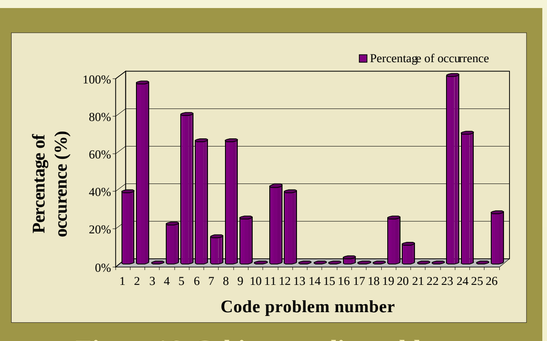


***Figure 16. Celtis australis* problems**

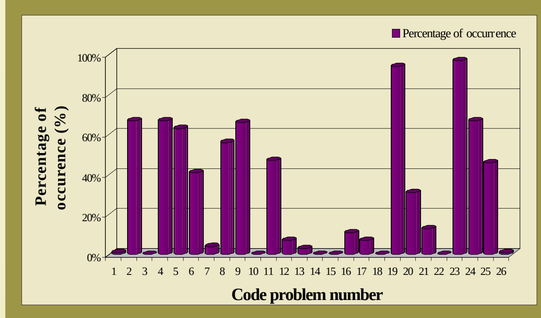


***Figure 17. Albizia julibrissin* problems**

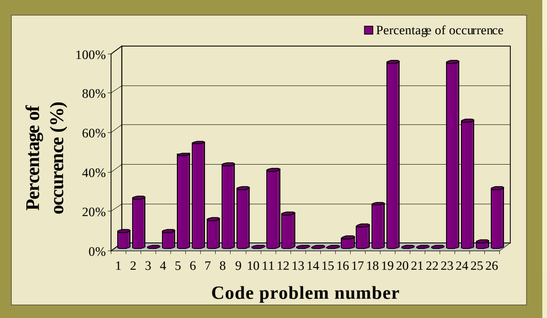


Figure 18. Populus X euramericana cv. 'I-45/51' problems

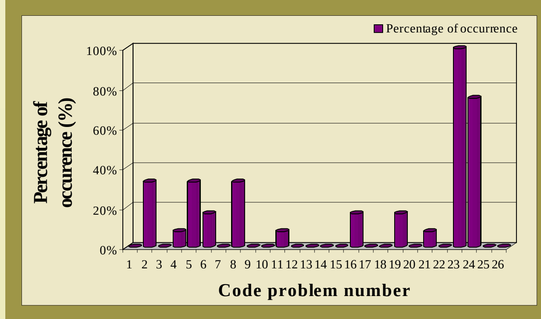


***Figure 19. Liquidambar orientalis* problems**

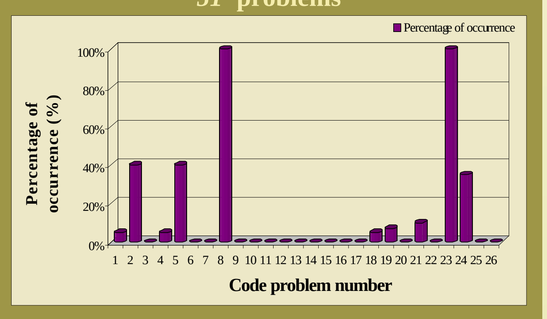


***Figure 20. Cupressus arizonica* problems**

4. CONCLUSIONS

The analysis of the results led to the following conclusions about the damages that the species presented the density of greenery in the three roads and the green volume indicator:

- The attacks on the leaves of *Platanus orientalis* and *Populus X euramericana cv. 'I-45/51'* by fungi and insects are mainly due to the limited available growing space and the insufficient soil and moisture conditions.
- The dry and broken branches that the crown of many species presents are due to the pruning method, which resulted in the development of tufts of branch shoots. These branch shoots had desiccation problems because of the self-thinning, which is a functional reaction of the plant to the excessive increase of branches. This problem is intensified by the insufficient soil and moisture conditions. In the case of *Cupressus arizonica* Green, the specific problem is due to the premature ageing that this species presents.
- The biggest density of greenery is presented in the Nikis Avenue, which is consisted by *Platanus orientalis*, because the values of the green surface indicator and green volume indicator are the biggest in this avenue. This conclusion results from the fact that the trees of *Platanus orientalis* have the biggest average values of height, height of the start of the crown, crown projection and breast diameter in relation to the trees of the other roads.
- With regard to the linear model that concerns the green volume indicator [Y = -104,048 + 14,64x (height) 18,73x (height of the start of the crown) + 3,48x (crown projection)], we must notice that it can be physically explained. The volume indicator increases with the increase of the height and the crown projection and decreases with the increase of the height of the start of the crown because the crown length decreases.

References

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