

PRUNING URBAN TREES – TYPE AND QUALITY ACCORDING TO ARBORIST UNION STANDARDS

Viera Paganová,* Michaela Vyhnáliková

Slovak University of Agriculture in Nitra, Slovak Republic

The aim of the study was assessment of the extent and structure of pruning within urban tree management in the public greenery and comparison of the quality with union standards on example of the city Nitra. In 2016, all interventions were carried out on street trees, on trees in the greenery of residential areas and around the apartment buildings. All pruning has been performed on adult trees (142 specimens in total). The basic data about pruning of trees in the public greenery were obtained from the register of the Department of Urban Greenery Management and Maintenance and City Services Centre in Nitra. Within the field survey the type of pruning and its technical accuracy were evaluated, as well as the quality of the pruning performed on trees in relation to the Arborist Standard "Pruning of Trees". The highest rate had reductive pruning due to improvement of the operating conditions around trees (59%) in the following structure: trimming of trees towards an obstacle (22%), crown reduction (27%), crown rising (9%), and local reduction (1%). In many cases, the reductive pruning was necessary due to inappropriate positions of the trees growing very close to buildings. Quite often, the reductive pruning was a consequence of the missing or neglected trimming during the juvenile stage of tree growth. Within the field assessment, a high rate of the crown topping (24%) connected with severe reduction of the trunk and branches were found, although in several cases, such intervention was not appropriate neither founded. Then, substantial part of the crown of a tree was removed (crown topping) instead of selective removal of branches (crown reduction). This error can be a result of a vaguely formulated subject of matter in the contract. The obtained results show that only 48% of the pruning were made in good quality and were technically correct. There were found discrepancies in the terminology and specification for procurement of the tree trimming in comparison with the Arborist Standard "Pruning of Trees". In several cases performance of trimming did not meet the arborist union standard. These facts can adversely affect the quality and purpose of the tree pruning in the cities. The results also show that in the future, greater attention should be paid to pruning of young trees. Guidance of growth of young trees and correction of growth defects is crucial for their successful growth and functionality, as well as for decrease in volume of the reductive and stabilizing pruning of adult trees.

Keywords: urban trees, tree pruning, urban areas, maintenance, standards

1 Introduction

In the urban areas, pruning of trees is a tool for their care and regular maintenance. Pruning and training trees and shrubs when they are young will help ensure good growth and long-term structural stability. The purposes of pruning young trees are correction of the growth defects and stable structure of their crown. In adult trees, pruning is used to enhance their operational safety – mechanical and biological stability.

The pruning techniques differ in the way the target branch and its apical portion are managed. A reduction cut reduces the length of a branch or stem back to live lateral branch of a sufficient size (at least one third to one half of the diameter of the removed portion) and should assume the apical role for the remaining branch

(Harris et al., 2004; Gilman, 2012). A heading (topping) cut reduces the length of stem or branch without regard to the position or diameter of nearby lateral branches. A removal cut removes a branch at its attachment to a trunk or a parent branch.

Responses of trees to the various pruning cuts are different. A type of pruning can induce massive sprouting, changed crown density or susceptibility of trees to storm damage, susceptibility to sun-injury or stem decay and cracks (Gilman, 2012).

The pruning methods and pruning techniques of urban trees and trees in open landscape applied for their regular maintenance in the Slovak Republic are defined in the arborist union standard "Pruning of Trees" (Paganová et al., 2015).



Viera Paganová, Slovak University of Agriculture in Nitra, Slovakia, Department of Planting Design and Maintenance, Tulipánová 7, Nitra, Slovakia, e-mail: viera.paganova@uniag.sk

The standard pruning methods for maintenance of adult trees are: health pruning, safety pruning and reductive pruning. Reductive pruning has several specific methods for maintaining operational safety of trees growing along roads and close to buildings.

Safety pruning reduces the risk of dead or damaged tree parts falling on the objects of value. There are removed dead, dying, diseased, damaged, detached, broken and hanging branches. This pruning method does not solve the complex static conditions of a whole individual (for example, the risk of a tree failure, a trunk break, a crown decay, etc.). In the case of unsatisfactory static properties of an individual, it is necessary to apply other technical solutions aimed at increasing the operational safety of a tree.

Health pruning supports tree health, vitality and operational safety in the long-term perspective. The maximum 20% of assimilation area of a tree is removed. This pruning is optimally carried out during the growing season. There are removed branches which decrease operational safety of trees, rubbing branches and shoots affected by pathogens and pests, mechanically damaged and broken limbs with reduced stability, codominant (competitive) shoots or branches with diameter up to 50 mm, secondary shoots with inappropriate position that grow into the crown.

Reductive pruning (called reduction) is the selective pruning to decrease height and spread of a tree. This pruning is used mainly to modify the operating conditions of a tree. Severity and placement of a reduction cut must be clearly defined in the design of the treatment. Regular tree care and control of a tree's operational safety must be ensured after the reduction pruning. The cut-off interval depends on the habitat conditions, growth and vitality of a tree and it is performed in accordance with the legislation. The length of a branch or stem should be reduced back to live lateral branch of sufficient size (Gilman 2012).

Crown reduction is aimed at removing the peripheral parts of the crown in order to reduce the impact area of the crown and shift the centre of gravity. It is intended for adult and senescent trees. The most pruning is done in the upper third of the crown, and downwards the size of removed branches and shoots decreases. The total reduction of assimilation apparatus within the intervention shall not exceed 20%. The original shape of the particular tree should be retained.

Crown rising is selective pruning to provide vertical clearance under the crown. The lower branches have to be removed to clear them from traffic or to prune them away from a building or a walk.

Crown topping – significantly reduces height and spread of trees. It is not recommended to be a regular practice. Heading large-diameter branches cause many problems, including massive decay in many species (Gilman and Knox, 2004). Topping causes extensive depletion of stored energy and occasionally kills trees (Gilman 2012). It should be done only if there is a threat of a static tree failure and when it is important to preserve a tree on a site for some time.

The Arborist union standard "Pruning Trees" can be used as a reference document for specification of the pruning and standardizing the quality in the area of the professional tree care and maintenance of woody plants. The standard is processed for care and maintenance of trees with non-productive functions. Pruning trees is a professional job that should be based on good professional skills and the knowledge of the biological properties of trees. Pruning is associated with some irreversible changes on trees. That can have a major impact on their further growth, development, function and life expectancy.

The aim of the study was assessment of the extent and structure of pruning within urban tree management in the public greenery and comparison of their quality with union standards on example of the city Nitra.

2 Material and Methods

In 2016, all interventions were carried out on street trees, on trees in the greenery near the apartment buildings (54%) and in the residential areas (30%) of the city Nitra. All pruning has been performed on adult trees, 142 specimens in total.

The basic data about pruning of trees in the public greenery were obtained from the register of the Department of Urban Greenery Management and Maintenance and City Services Centre in Nitra. The information about pruning has been processed in the form of a table with a number of tree, taxon identification, its location, and type of pruning according to the customer's order.

Within the field survey from January to April 2017 the type of pruning and its technical accuracy were evaluated, as well as the quality of the pruning performed on trees in relation to the arborist standard "Pruning of Trees".

In the next step a description of the pruning has been processed for each tree. The following was defined: the type of pruning, its extent and relevance in relation to the life stage of a tree and the operating conditions. The compliance of terminology in the list of pruning made in 2016 was assessed in comparison with the

Arborist Standard within the detailed analysis. Finally, the structure of pruning made on urban trees and the technical accuracy of cuts made on trees in the public greenery were evaluated.

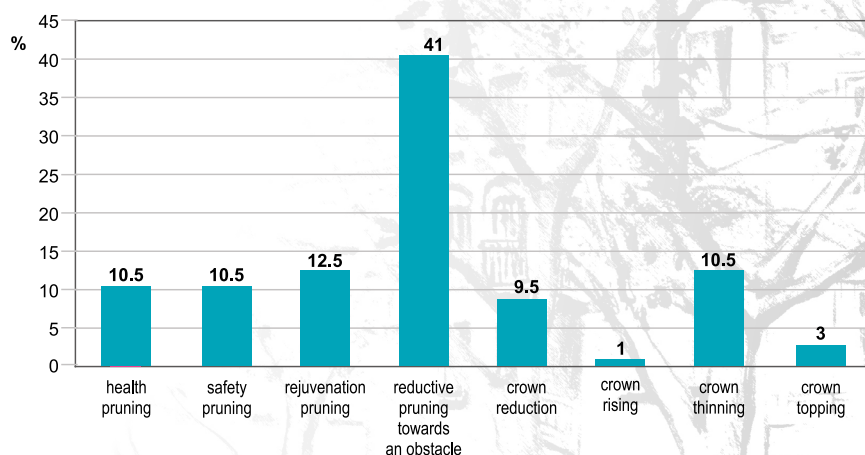
3 Results and Discussion

All woody plants that were pruned in Nitra in 2016 are adult individuals in the reproductive stage of growth. The species structure of pruned trees was quite large, the highest rate had the following taxa: *Acer pseudoplatanus* (21%), *Betula pendula* (18%), *Tilia cordata* (16%), *Cerasus avium* (4%), *Negundo aceroides* (3.5%), *Carpinus betulus* (3%). Further 27 taxa were represented by less than 4 individuals. The analysis of pruned trees and the operating conditions of their habitat resulted in the following findings:

1. Trees have not been maintained systematically in the past and many of them have growth defects that could be eliminated at the earlier stage within regular training.
2. Several woody plants were not planted on the right place. Now, they are in the conflict with a building and site operational conditions, or habitat conditions do not meet the ecological requirements of the particular specimen.
3. Purpose of the pruning was in majority a case to maintain the operational safety of trees or to improve the health and vitality of the trees.

3.1 Assessment of the extent and structure of the urban tree pruning in Nitra in 2016

The request for a certain type of pruning on trees in the public greenery of the city Nitra is released by the Department of Urban Greenery Management and Maintenance. The request is defined as the purpose of pruning for each tree and listed in the subject of the contract. In 2016 the purpose of pruning was not uniformly defined in the register, even when it was the same type of pruning requested for different trees. Therefore, within assessment of the type of requested and performed pruning, there was used a uniform terminology.



■ **Figure 1:** An overview of pruning, that was planned and requested for trees in Nitra in 2016. There was dominant reductive pruning related mainly to solving the conflict of trees and buildings and to improve operational conditions around apartment buildings

An overview of ordered pruning on urban trees in Nitra, requested by the Department of Urban Greenery Management and Maintenance, is processed on a graph (Fig. 1). In 2016, reductive pruning (51%), namely reduction towards an obstacle (41%), crown reduction (9%) and crown raising (1%), were planned in Nitra. Furthermore, crown thinning (12.5%) and rejuvenation pruning (12.5%) were planned. The request for last two pruning methods is considered to be a non-standard.

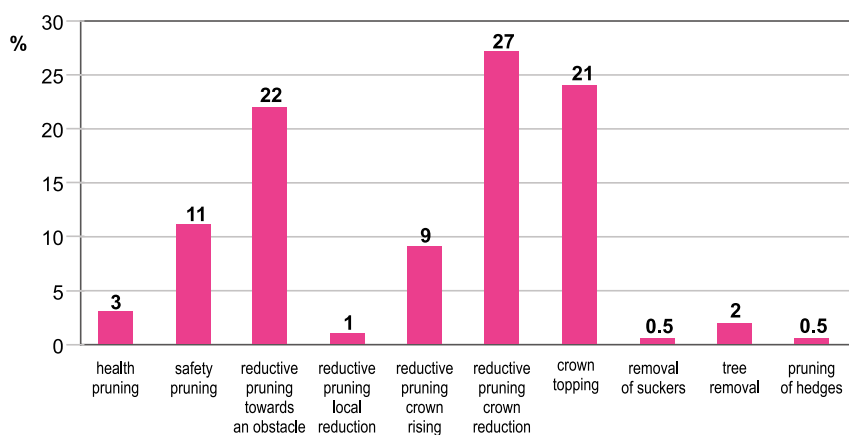
In the arborist union standard (Paganová et al., 2015) crown thinning is included under the health and safety pruning. It is not classified as a particular type of pruning.

The order of rejuvenation pruning on urban trees is probably based on fruit-growing practice. The principle of rejuvenation pruning is disturbance in the ratio between aboveground and underground organs of a tree in the favour of the root system. Reduction of growing points will support elongation of remaining shoots. The aim of pruning is to enhance growth of a tree (Paulen, 2013).

In urban areas, weak tree growth can be influenced by site conditions, such as shade from surrounding buildings, competition of other trees, interventions within the root zone, soil contamination, etc. In such cases, reduction of the aboveground organs may increase stress and weaken a tree. The rejuvenation pruning was requested for several trees in Nitra. However, their weak growth is often a result of shading and competition (Figure 2). In this case, a very close canopy impacted growth of light-demanding woody plants. The purpose of pruning was not met. Cutting off some weaker



■ **Figure 2:** SEQ FIGURE * ARABIC 2 The rejuvenation pruning was requested for these trees growing close to each other.



■ **Figure 3:** Structure of the pruning that was really performed on urban trees in Nitra in 2016

growing individuals would be more effective.

In professional arboriculture effective rejuvenation of adult trees is achieved by their regular and targeted maintenance. The method of health pruning is optimal. Above to damaged and unstable branches also codominant (competitive) shoots or branches with diameter up to 50 mm, secondary shoots with inappropriate position that grow into the crown are removed within this type of pruning. A maximum of 20% of the crown's assimilation area is removed.

In 2016 the health and safety pruning were planned on urban trees in extent of 10.5% (Figure 1). The crown topping was ordered for 4 trees (3%). Within the crown topping large-diameter branches are shortened and a substantial part of tree crown is reduced. The aim of such significant intervention is to reduce the risk of failure of trees with wood decay or disturbed stability. Crown topping has negative impact on trees (Gilman 2012). It is therefore inappropriate to perform crown topping on healthy trees with a primary crown. Regular inspection and systematic care are necessary after this type of pruning.

3.2 Evaluation of the structure and quality of the pruning performed on trees in Nitra

Within the field survey, the nature and quality of pruning were evaluated to assess the compliance of the ordered pruning on trees in public greenery in Nitra with the arborist standard "Pruning of trees". The analysis (Figure 3) shows that reduction pruning had the highest rate (59%). There was done mainly crown reduction (27%), a reductive pruning towards an obstacle (22%), crown rising (9%) and a local



reduction (1%). Quite a high rate of the crown reduction is interesting. According to the plan, this method of pruning was ordered for 9% of trees, but in reality it was performed on 27% of trees. The higher rate of crown reduction is probably the result of inappropriate and stronger pruning performed on individuals, where health pruning or safety pruning were requested.

The safety pruning was performed on 11% of trees and health pruning on 3% of trees. The performance of these types of pruning was originally planned in a larger extent (Figure 1). However, the character and severity of the cuts actually made on trees were different. The technique of pruning and the volume of reduced assimilation area corresponded more to crown reduction.

Three specimens were removed above the plan (2%) as they probably did not meet criteria of the operational safety within expert inspection. A local reduction towards the facade of the house was originally ordered for these trees. In one case, trimming of a hedge was performed, as well as removal of tree suckers.

Compared with the plan, crown topping was carried out on a higher number of city trees (24%). The rise of this type of pruning is related to the removal of a larger volume of the assimilation area within crown reduction. Within proper method of crown reduction, the limbs are shortened in the upper third of the crown, and downwards the size of removed branches and shoots decreases. Branches are reduced back to live lateral branch of sufficient sizes. The total reduction of assimilation apparatus within shall not exceed 20%. In fact, pruning performed on many trees did not meet these principles and rules. In the residential areas several trees were reduced by heading cuts and shortened to the height of nearby residential buildings.

According to literature (Cline, 1996; 1997; Martin, 1987; Gilman and Grabosky, 2009; Fini et al., 2013; Clark and Matheny, 2010) the pruning method, not only its severity, modulates the morpho-physiological response of trees to pruning. Maintenance of apical control and apical dominance are key issues to preserve a structurally sound tree structure, as well as the long-term efficiency of the photosynthetic apparatus.

The research done by Fini (et al., 2015) showed that the removal of the whole primary axis at its attachment to the trunk provide minimal disturbance to tree physiology. However, shortening of the branch may provide different results. Authors found out that the reduction of the primary axis to a lateral branch large enough to become the new branch leader appeared

to preserve normal branching pattern and had little effects on the leaf structure of trees and photosynthetic performance. On the contrary topping a branch (shortening of the primary axis without providing a substitution leader greatly affected tree structure and functioning.

Significant reduction of the main branches and assimilation area weaken trees. Large wounds occur due to cuts made on thicker branches, and are often followed by massive dieback. Loss of the assimilation area has a negative impact on the root system of trees, which do not have enough resources for further growth.

The technical accuracy of cuts was also evaluated. The findings are very serious; more than a half of pruning (52%) was not performed properly. The most frequent mistake was flush cut, when the bark ridge was removed and enlarged the wound area. Branch stubs were left quite often. There was also found the dominance of heading cut which shortens back branches and stems to a node without an existing lateral branch. Heading often results in dead stubs when nearby buds fail to sprout (Gilman 2012).

4 Conclusions

Within the field survey there was found out that many of trees were not planted on the right place. Now they are in conflict with buildings and site operating conditions. Sometimes, habitat conditions do not meet ecological requirements of a particular taxon. These trees were not maintained regularly during earlier stages of growth (when they were young). Many of them have growth defects which could be eliminated within regular training of young trees.

Due to this situation the structure of planned and executed pruning is aimed to maintenance of the operational safety of these trees. Reductive pruning has the absolute dominance (59%) which should improve operating conditions near the trees. Safety pruning (11%) and health pruning (3%) have lower rates. The obtained results show that in 2016, the maintenance of adult trees had absolute priority in the city Nitra.

There was found a relatively high occurrence of crown topping (24%), which has a negative impact on trees. This method of pruning should be used as an alternative to removal of statically unstable trees. Quite high frequency of crown topping and heading cuts performed on trees in Nitra is the result of improper technique of pruning, when more than 20% of the assimilation area of the crown is removed and the main

branches significantly reduced by heading cut without retained lateral branches.

Some faults have also been found in the pruning technique, they indicate that pruning of urban trees was not carried out properly.

The results pointed out importance of uniform terminology in the planning and ordering of pruning, as well as the need to comply with the standards of urban trees pruning.

The results also show that in the future, higher attention should be paid to pruning of young trees in city Nitra. Guidance of growth of young trees and correction of growth defects is crucial for their successful growth and functionality, as well as for decrease in the volume of the reductive and stabilizing pruning of adult trees.

Acknowledgements

This work was supported by AgroBioTech Research Centre built in accordance with the project Building "AgroBioTech" Research Centre ITMS 26220220180 and project KEGA Development and implementation of the standards for urban greenery management. Project registration number 003SPU-4/2017.

References

CLARK, J.R. – MATHENY, N. 2010. The research foundation to tree pruning: a review of the literature. In *Arboriculture and Urban Forestry*, 2010, no. 36, pp. 110–120.

CLINE, M. 1996. Exogenous auxin effects on lateral bud outgrowth in decapitated shoots. In *Annals of Botany*, 1996, no. 78, pp. 255–266.

CLINE, M. 1997. Concepts and terminology of apical dominance. In *American Journal of Botany*, 1997, no. 84, pp. 1064–1069.

FINI, A. – FERRINI, F. – FRANGI, P. – PIATTI, R. – FAORO, M. – AMOROSO, G. 2013. Effect of pruning time on growth, wound closure and physiology of sycamore maple (*Acer pseudoplatanus* L.). In *Acta Horticulturae*, 2013, no. 990, pp. 99–104.

FINI, A. – FRANGI, P. – FAORO, M. – PIATTI, R. – AMOROSO, G. – FERRINI, F. 2015. Effects of different pruning methods on an urban tree species: A four year experiment scaling down from the whole tree to the chloroplast. In *Urban Forestry and Urban Greening*, vol. 14, 2015, no. 3, pp. 664–674. DOI:10.1016/j.ufug.2015.06.011

GILMAN, E. F. 2012. Illustrated guide to pruning. 3rd ed., Delmar : Clifton Park, 2012, 476 p. ISBN 978-1-111-30730-1.

GILMAN, E.F. – KNOX G.W. 2004. Pruning type affects crapemyrtle. In *Journal of Arboriculture*, 2004, no. 30, pp. 48–53.

GILMAN, E.F. – GRABOSKY, J.C. 2009. Growth partitioning three years following structural pruning of *Quercus virginiana*. In *Arboriculture and Urban Forestry*, 2009, no. 35, pp. 281–286.

HARRIS, R.W. – CLARK, J.R. – MATHENY, N.P. 2004. *Arboriculture: integrated management of landscape trees, shrubs and vines*. 4th ed., Prentice Hall, Upper Saddle River, NJ, 2004.

MARTIN, G. 1987. Apical dominance. In *Hort. Science*, 1987, no. 22, pp. 824–833.

PAGANOVÁ, V. – KOLLÁR, J. – RAČEK, M. – FRAŇO, T. – HUDEKOVÁ, Z. – KOLNÍK, M. – TRNOVSKÝ, M. – ZELENÁK, M. – KRIŠTOF, M. – SKLENÁROVÁ, M. – KOLAŘÍK, J. 2015. *Arborist standard : Pruning of trees* (in Slovak language). 1st ed., Nitra : SUA, 2015, p. 31. ISBN 978-80-552-1402-3. DOI: <http://dx.doi.org/10.15414/2015.9788055213644>

PAULEN, O. 2013. *Pruning of fruit trees 2013*. 1st ed. (in Slovak language), Baštan : Olomouc, 2013, 218 p. ISBN 9788087091432.

