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Potential utilization of some arboreal species' by-products in composting and floral art

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Abstract
This paper is part of a doctoral thesis that proposed a high performance solution for the contribution of mankind in greening the planet through education and awareness. The chosen topic is based on bringing in front of the general public a subject that in our country is often out of sight- the circular economy - the industrial economy that is created with the purpose of allowing recycling or reuse of materials and in which their cycle is of two kinds: *biological*, where processes act in such a way that the components re-enter the biosphere without negative effects; and *technica*l, where components are used very efficiently and do not enter the biosphere. Starting from these two basic components, we have set ourselves two clear objectives: the use of by-products in floral art and the reuse of plant material resulting from the pruning of trees in compost preparation. The importance of the chosen theme is given, on one hand, by the guarantee of the total utilization of the by-products used and their transposition into raw materials necessary in the realization of decorations and, on the other hand, by compost preparation. The paper presents floral compositions that contain the by-products of the tree and shrub species chosen as biological material, emphasizing the artistic side, without presenting calculations of economic efficiency and other aspects that will be presented in other works.

Keywords: trees and shrubs, by-products, floral art

Introduction

Wreaths, garlands and wall arrangements have been used to decorate homes since ancient times. Wreaths are used as a sign of distinction and appreciation, but also for funeral ceremonies, as the Greeks consider them to be a symbol of eternity.

To make wreaths for jubilees, funerals or winter celebrations, it is necessary to know certain specific rules.

The Greek or Roman wreath has a circular shape and is widely used as an ornament, for holidays and other festive occasions. It is fixed on a support made of hazel or willow twigs, woven in a circular shape and tightened with wire [9].

Plant materials used as a base for the wreaths consist of pine, spruce, yew, Douglas-fir, *Thuja* sp., silver fir, leafy moss or decorative vines (*Hedera* or *Parthenocissus*) as well as shubs leaves such as laurel or *Ficus bengalensis*, which are placed one on top of the other. Fresh plant material is used to decorate the wreaths; it can consist of annual flowers: *Callistephus*, *Zinnia*, *Tagetes* etc.; perennial flowers: *Aster*, *Paeonia*, *Rosa* etc.; greenhouse flowers: *Dianthus, Gerbera, Chrisanthemum* etc. Dried plant material such as straw, cones or dried fruits are also used, and *Poinsettia* - the Christmas star - is often used for Christmas wreaths, along with other auxiliary materials such as globes, ribbons, candles etc.

For the realization of arrangements made of dry materials, special operations applied to these materials are required, such as coloring and varnishing. Coloring can be carried out by dipping the plant materials in a coloring solution (beech, maple, oak or chestnut leaves or by spraying the fruits, herbs, cones etc. with coloring substances [13]. Varnishing is a process by which varnish is applied to cones of all kinds (chestnut, acorn, walnut etc.), the luster they acquire making them more attractive and easier to integrate into the arrangement.

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Material and Method

The experiment is located in Lugoj Municipality, which is situated in the SV of the country, on the banks of the Timiș river, the southern extremity of the administrative territory being at 4539'04" lat.N, and the northern one at 4545'36" lat. N [15].

The biological material chosen for the study consisted of 18 tree species, those most commonly found in parks, alignments and other categories of green spaces managed by Lugoj City Hall.

1. ***Pinus sylvestris***. Scots pine is easily recognizable, a slender tree with needles grouped in groups of two, which gives off a resinous aroma, beautiful and pendulous cones with a special color and shape. It presents a wide range of cones of different shapes and sizes, allowing them to be used in various decorations under multiple uses both indoors and outdoors. Scots pine occupies a huge area and is one of the most widespread species in the world. The specimens on Fagetului Street were taken into study (Figure 1).

Figure 1. Pinus sylvestris

Figure 2. Juglans regia

Figure 3. Pinus strobus

Figure 4. Alnus glutinosa

2. ***Juglans regia***. A popular tree, the most widespread nut tree [10], noted for the diversity of its fruit shapes. Known and used both by housewives in the kitchen and by artists in their various creations. Native to south-eastern Europe and Asia, its growing area covers the Balkan Peninsula, Asia Minor, Iran, Himalaya, China, Pakistan, India. The specimens from Closca Street (Figure 2) have been studied.

3. ***Pinus strobus.*** Also known as the smooth pine, it is an exotic species native to North America. It is found on a great surface. It can be found in the Himalayas at altitudes ranging between 1600 and 4000m, in areas characterized by a humid climate, in pure or mixed arboreta with *Cedrus deodara* or *Abies pindrow*. On the national territory it is cultivated as an ornamental tree and is particularly decorative due to the color of its needles (bluish-brown) and their length. The specimens from Aurel Vlaicu street were taken into study (Figure 3).

4. ***Alnus glutinosa.*** A deciduous, water-loving tree with a smooth bark, the fruits clustered in bunches, small in size and easily mistaken for pine cones. It is a very wide-ranging species, occurring throughout the European continent, from Scandinavia to the Mediterranean countries, including Morocco and Algeria [1]. It is most widespread in the boreal zone, less so in the temperate zone, and it can be found isolated in northern Africa. The specimens from the Splaiul Tinereții (Figure 4) street were studied.

5. ***Malus x purpurea.*** It is a commonly cultivated ornamental hybrid, it has very decorative leaves, flowers, and is also very decorative at the beginning of winter due to the persistence of the fruit. It is a tree with small height, with purple young branches, 8-9 cm long ovate or oblong-ovate leaves, purple when young, then dark green, shiny on the ventral side. It blooms as soon as leaves appear, in May, and has 3 cm in diameter, pinkish-red or purple flowers. Native to Southeast Asia, but present in many areas of the word. Specimens from the Parcul Gării have been studied (Figure 5).

6. ***Picea abies***. Norway spruce is a species very sensitive to insect and fungal infestation and is often the victim of real disasters in this respect. A real specific environment generator, it influences both the internal climate and the soil. Its crowns create a shady, cold and damp environment, devoid of air currents; snow intercepted in the crowns sometimes reaches 40% of the entire falling amount. Under these photoclimatic conditions soils acidify. The undecomposed or partially decomposed detritus is deposited as coarse humus - thick, or moderate layers. It is a species of Western, Central and Eastern Europe, where it has essentially a mountainous range - the south-eastern European alpine region and the Carpathian region. The specimens from the Splaiul Brediceanu (Figure 6) were studied.

7. ***Aesculus hippocastanum***. Decorative both by the imposing flowers that give the impression of chandeliers, with a special. pinkish-white, color explosion, and by the fruits protected by a spiny cupule (burr), which opens when they fall on the ground. Both the burr and the chestnut itself are frequently used in various decorations, their presence being visible in decorative creations. An exotic species native to the Balkan

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Peninsula and Asia Minor. In our country it is cultivated in parks and gardens or street alignments. The specimens from George Enescu Park have been studied (Figure 7).

Figure 5. Malus purpurea

Figure 6. Picea abies

Figure 7. Aesculus hippocastanum

Figure 8. Platanus hybrida

8. ***Platanus hybrida.*** Popular tree famous for its resistance to diseases and pests [11], decorative both by its leaves and fruits, it can be found in parks and forests. The fruit has a globular shape; it is recommended to be used in more complex compositions with other fruits. Native to North America, it is rarely found in our country, only as an ornamental species. The specimens from G. Enescu Park have been studied (Figure 8).

9. ***Taxodium distichum.*** A deciduous tree native to North America, coastal and low-lying regions of the Atlantic Ocean and Gulf of Mexico. Inland, it forms a narrow strip along the Mississippi River. The species plays a particularly important role in water and soil conservation [7]. The specimens from Cernei Street (Figure 9) were taken into study.

Figure 9. *Taxodium distichum*

Figure 10. *Acer platanoides*

Figure 11. *Quercus coccinea*

10. ***Acer platanoides.*** A magnificent tree with large leaves with three variously colored lobes. The fruit consists of two seeds, with broad, obtuse-angled wings. Indigenous tree, its growing area coincides with that of the mountain rose, but it exceeds it in the north, occupies territories from Scandinavia and Finland to the Ural Mountains. In our country it is found mainly in the hills and plains (in the scrublands), in the mountains more rarely, sporadically, in beech forests and in mixed coniferous and beech forests. The specimens from Gheorghe Doja Street were studied (Figure 10).

11. ***Quercus coccinea.*** The famous oak that surprises us by its huge silhouette, presenting a luxuriant, voluminous crown whose fruits are food for wild animals, but also used as raw material for peat production is also used as a decorative element in floral compositions. Native to eastern North America, in our country is frequently cultivated for decorative purposes in parks or roadside alignments, but also in plantations in the western part of the country. The specimens on Buziasului Street have been studied (Figure 11).

12. ***Corylus avellana.*** The hazel is found over a wide range, both in Europe and Asia Minor. In our country it is found in warm, sunny areas on limestone, it climbs up to the spruce subzone at an altitude of 1400 m, in the flatlands it descends sporadically to the forest-steppe. It requires fertile, nutrient-rich, relatively weakly acid, often skeletal soils, protected from dryness. It develops in a normal regime in full light, but it is specific to shady and semi-shady areas. Specimens from the Aleea Pinilor were studied (Figure 12).

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Figure 12.*Corylus avellana*

Figure 13. *Larix decidua*

Figure 14. *Betula pendula*

13. ***Larix decidua***. It is unique because it copies the "habits" of its neighbors in the deciduous forest, shedding its needles in late autumn, remaining dressed with the cones grouped in small clusters, keeping them over the years. Imposing in its height and arrangement of branches, it is also distinguished by the delicacy and color of the needles that dress it in early spring. Thanks to its great adaptability to temperature fluctuations, this species has also adapted perfectly to warmer, or moderate climatic conditions. Larch is a European species with a fragmented growing area, concentrated almost exclusively in mountainous areas. It grows naturally in the mountains of Western and Central Europe, especially in the Alps, in the Maritime and Western Alps of France. The specimens from Strada Caransebeșului have been studied (Figure 13).

14***. Betula pendula.*** Silver birch has an extensive range, that extends from the shores of the Atlantic to Siberia and the Altai Podis. Across the European and Asian continents, at the latitudinal confluence of the forested areas, above the polar circle, and in the southit reaches the Apennines and the Balkans, and the forrest-steppe in Russia. In the Danubian Carpathian area it is found in mountainous areas at 700-1550 m, sometimes descending to 250 m. In terms of ecological parameters, it can be compared with Scots pine. It is a hardy species, not very demanding in terms of pedoclimatic conditions. It successfully withstands freezing winter episodes, extreme heat and late frosts. The specimens from the Parcul Strand, on the Splaiul Plopilor (Figure 14) have been studied.

15. ***Pseudotsuga menziesii.*** An exotic tree from western North America, which appeared in Europe a century and a half ago. The Banat area is a favorable site for the harmonious development of Douglas fir plantations. It is more drought resistant than spruce and fir. The specimens on Cernei Street were studied (Figure 15).

Figure 15.*Pseudotsuga menziesii*

Figure 16. *Pinus nigra*

Figure 17. *Catalpa bignonioides*

Figure 18. *Paulownia tomentosa*

16. ***Pinus nigra***. Classified as an exotic species, black pine is found in a more limited range than Scots pine, in the south-west of France, in the Italian and Austrian Alps, in the Balkans, Turkey, Ukraine, or in the Iberian Peninsula, and even in North Africa. We can find it in restricted areas in our country in the Banat area. The specimens from Gh.Doja Street were taken into study (Figure 16).

17. ***Catalpa bignonioides.*** This species has large white flowers clustered in panicles, with long, striated, decorative fruits used in various arrangements. Decorations containing the fruit of this species have

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an unusual appearance, pleasantly surprising the viewer. Due to the structure of the fruit, the paint applied radically changes its appearance, making it unmistakable. The species is native to North America, in our country cultivated for ornamental purposes in the plains, hills and foothills. The specimens on Timotei Popovici Street were taken into study (Figure 17).

18. ***Paulownia tomentosa.*** A tree with a special growth habit (it can reach up to 20-30 m) [8], it is distinguished by its large, heart-shaped leaves and the flowers that have a tubular white-purple color. The fruit is a dehiscent, ovoid capsule, with two walves. It can be used in various decorations, its fruits being a versatile element in the art of creation. It is an exotic species, native to China, cultivated in our parks and gardens. The specimens from the Victoriei Square have been studied (Figure 18).

We would like to mention the fact that this paper presents partial results of the PhD thesis, which focuses on two main research objectives, namely the use of by-products in floral art and the reuse of plant materials resulting from the tree cuttings in obtaining composts [6]. Out of the secondary objectives proposed we will present only the following aspects:

- Identification of the above-mentioned trees and shrubs in order to determine the species;
- Mapping (establishing the position) of trees and shrubs;
- Determining the tree species to be studied;
- Sorting and preparation of raw material in order to make the decorations and their arrangement

In order to identify the trees and shrubs [2,3,4,5], that we studied, we used the green cadastre maps of Lugoj Municipality, after which the specimens were located on the field, and to which the current care works from the city hall protocol were applied; thus we could carry out the sorting and preparation of raw material for the decorations, but also weighing operations, processing by chopping and compost preparation according to agrochemical research methods [12,14].

To make the arrangements and decorations, elements from the sorting of plant materials resulting from specific operations were used.

Results and Discussion

There are a total of 17.765 trees in Lugoj municipality, as it results from the analysis of the data entered in the Green Spaces Register. Deciduous species are present predominantly. The last update was carried out in 2021.

Figure 19. Green Spaces Register Lugoj

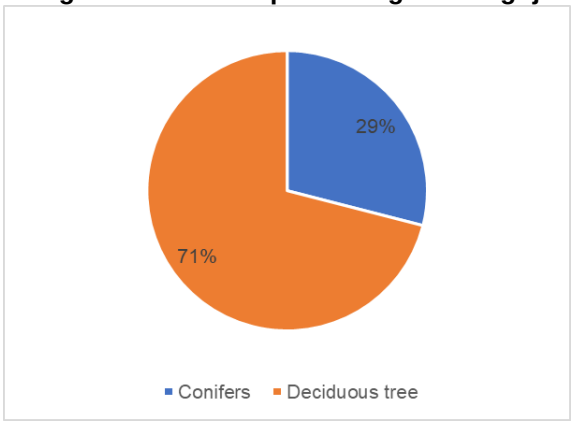

Figure 20. Tree classification according to the Green Spaces Register in Lugoj municipality

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Concerning the use of trees and shrubs by-products in the realization of different floral arrangements we will present some compositions realized for the winter holidays 2023. The sorting of the by-products is executed according to the element integrity criterion, the aesthetic criterion and the creativity criterion.

The element integrity criterion refers to the selection of pieces that present all of their morphological components. The aesthetic criterion, which is of an eminently subjective nature, refers to the selection of well-defined forms that meet the requirements of the doctoral candidate, thus being inserted into the floral art. The creativity criterion is based on the idea of transposing the emotions and feelings of the creator of the decorations into the floral art, as well as adapting it to the needs of the community. In another way, it is the way in which the artist adapts to the events taking place in the community.

The resulting plant remains that do not meet the above criteria are intended to be used either as growing substrate or as decorative mulch.

Figure 21 shows wreath arrangements and accessory material made from cut larch fruit.

Figure 21. Compositions made from cones and plant material from *Larix decidua*

In Figure 22 it can be observed arrangements made from fruit fragments of *Pinus sylvestris* and *Pinus strobus*.

Figure 22. Compositions made from cones and plant material from *Pinus silvestris* and *Pinus strobus*

Figure 23.a shows a composition made of spruce species; the beautiful cylindrical cones allow transformation into different shapes, and can be complementary to other decorations specific to the winter holidays. In Figure 23 b, the artist's desire to realize a new concept of a fir tree is based on the suffering caused by cutting down too many trees during the winter holidays. By creating this unique and innovative design, a natural fir tree model is obtained with the dimensions desired by every beauty lover. The bark stripped from the support is then used to produce compost.

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a **b**

Figure 23. Compositions made of *Picea sp.*(a) and *Abies alba* (b)

Figure 24. shows compositions made of chestnut and alder; in the case of chestnut, both the spiky capsule and the chestnut itself are frequently used in various decorations, their presence being visible in the decorative creations, while alder fruits grouped in small bunches are interesting by the appearance they have when ripe, thus being suitable for decorative creations with different concepts. Other elements described in the paper were also used in the composition.

Figure 24. Compositions made of *Aesculus hippocastanum* and *Alnus glutionsa*

Figure 25. shows a composition made of red oak whose fruits are food for wild animals, but also used as raw material for peat/compost production, as well as a decorative element in floral compositions, and a wreath made of walnuts that can be used for decoration during the winter holidays.

a **b**

Figure 25. Composition made of *Quercus coccinea (a)* and *Juglans regia(b)*

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Figure 26. show compositions made of plane-tree leaves in the shape of a palm, with slightly lobed edges (a), as well as a composition made of double samara maple fruits, provided with diverging wings at an obtuse angle, giving it a butterfly-like appearance (b).

a **b**

Figure 26. Compositions made of *Platanus hybrida* (a) and *Acer platanoides* (b)

Figure 27 shows compositions made of Paulownia capsule fruits, positioned on a sycamore trunk (a), as well as an elaborate composition made of young branches, imposingly intertwined, and trunks particularly decorative in any season due to the white veining (b).

a **b**

Figure 27. Compositions made of *Paulownia tomentosa* (a) and *Betula pendula* (b)

In Figure 28.it can be observed compositions made of *Taxodium* fruits resembling small cones of about 2-3 cm, which when ripe open and spread a strong resin fragrance (a), as well as the basic structure, made of *Malus* branches, which serves as a support for the wreaths (b).

a **b**

Figure 28. Compositions made of *Taxodium distichum* (a) and *Malus x purpurea* (b)

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Figure 29. shows a composition realized from *Corylus avellana* whose edible fruit is positioned on straight stems which at maturity have longitudinal striations, thus being found in different compositions. As both the fruit and the branches (a) are decorative, the fruit of *Catalpa bignonioides* is a 20-40 cm sized pod, which is why it is often found in decorations (b).

a b

Figure 29. Compositions made of *Corylus avellana* (a) and *Catalpa* (b)

Conclusions

The main reason that brought into discussion the importance of the valorization of by-products found in nature was their translation into raw materials needed in the decoration-making procedures. The importance of the chosen topic is given by the guarantee of full utilization of the by-products used.

The doctoral candidate's wish is to be original by carefully selecting by-products found in nature, becoming a component part of floral art. Due to the fact that the environment in which we live is an increasingly polluted one, a purely ecological creative process is less and less encountered and more and more appreciated.

The creations are the result of by-products with potential for recycling: cones from different resinous trees, fruits from deciduous trees, branches and leaves of different types and shapes. Such a process involves 100% natural material and organic finishing elements, binding elements such as hemp twine, flax tissues, hay fillings, moss, etc.

Following the selection of by-products, unsuitable by-products are destined for the peat process.

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