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STUDY ON THE USE OF THE PLANT AS POLLUTION SOUND ATTENUATOR

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Abstract: *The paper presents a study of the documentary on the use the plant over the pollution as a sound attenuator. The vegetable kingdom proved over time a good attenuator of pollution. It is search for found those systems, which produce a good sound attenuation in the industrial environment. This paper is part of a study regarding the assessment of noise pollution in industrial activity.*

Key words: *professional noise, vegetable sound attenuation, industrial activity.*

1. GENERAL CONSIDERATIONS

At present there are several ways to minimize noise pollution of our homes, such as:

1. Location of houses in residential areas and factories in industrial areas dedicated them;

2. Using white noise machines – which are, in fact, machines that convert the troublesome noises in pleasant noises, such as a music or soothing sound of the sea, of the wind. These devices must be between the source and the status of receiver;

3. Planting of trees and shrubs around the House-to isolate the sound of the sound of the street, and of the industrial noise pollution [2].

2. PLANTS – EXTERNAL ISOLATOR

According to the USDA National Agroforestry Center – checkpoints along the highways that are made of trees and bushes reduces noise by 5 to 10 dB, in fact, reduce the noise perceived by the human ear by about 50%. To achieve maximum absorption must design and plant species should be chosen carefully so as not to inhibit each other [3].

In fact, the plants absorb, diffract and reflect sound waves. General recommendations are to use strips of trees and bushes with dense foliage, and closer to the sound source than the area to be protected (Fig.1).

It prefers broad-leaved species persisting because they provide protection all year round, with different shapes and foliage throughout the length of the stem, if possible [1].

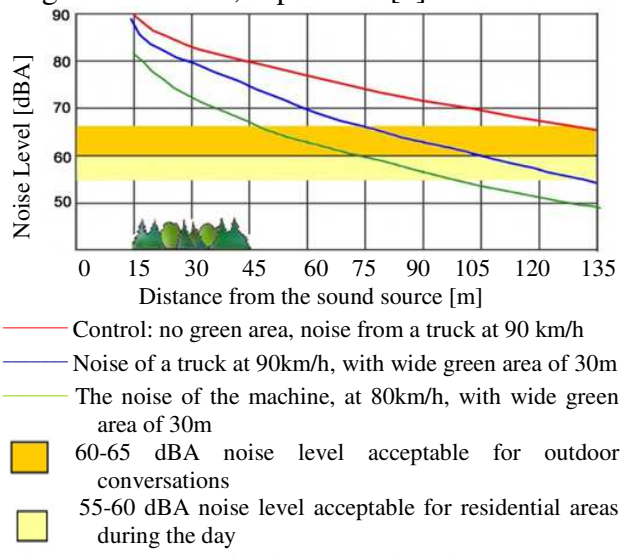

Fig. 1. Decrease of noise level with distance due to a green area with trees and bushes [4]

In the chart above are observed, without the green sound level is higher than permissible limits even at over 120 m from the source.

In the case of green areas, the noise level drops from 80 dBA to 75 dBA for trucks and to 67 dBA for the cars just after the green zone and decrease continues so to 120 m towards the sound source we have a noise level below the allowable limits.

In the graph below, the existence of a platform of Earth with a height of 1 m, which have planted trees and bushes do that immediately after this green area, noise levels would be reduced to 80 dBA to 70 dBA, in the case of trucks and 60 dBA in the case of passenger cars, the fall in continuing with increasing distance. Attenuation is stronger in the case of cars than trucks, thanks to the platform of land which exceeds the height of the cars and trucks but not height (Fig. 2).

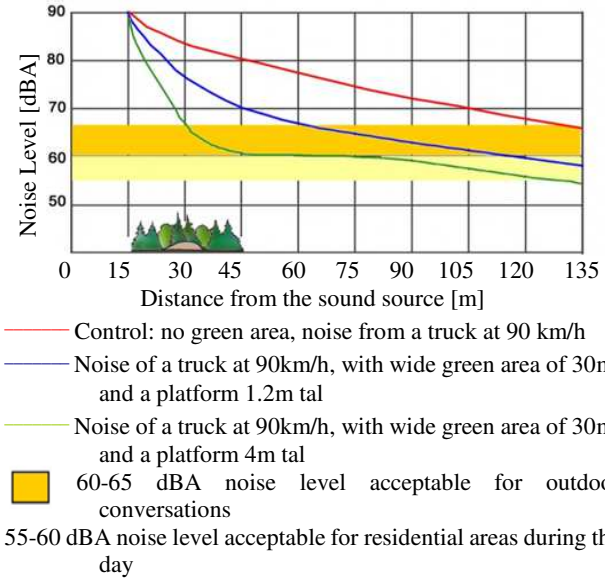

Fig. 2. Decrease of noise level with distance due to a green area with trees, bushes, and a platform [4]

3. PLANTS – INTERNAL ISOLATOR

Reducing the level of noise is one of the lesser-known benefits of plants.

Thus through the absorption, reflection and diffraction sound waves, plants are able not only to delight the eye, to regulate humidity, CO_2 levels, but also to reduce the echo produced by the reflected sound waves that are hitting walls repeatedly.

3.1. Classification and benefits

There are several methods to put of plants in a work space to minimize the noise level:

- solitary plants;
- arrangements of 3-5 plants at various levels;
- vertical gardens-green walls.

Green Walls enhance the pithy manner level of attention, inspiring talk and energy of employees. Can be mounted both inside and outside buildings, and do not occupy place only vertical. Like all plants absorb CO, CO_2, NO_x and other benzene inside buildings but in larger quantity than the arrangements.

It reduces energy consumption because outside and inside isolation grows, so during the summer, reduce the temperature by 10 °C (through vapor-transpiration) and winter while maintaining constant temperature.

3.2. Factors influencing the uptake of sound pollution on plants

Some plants absorb more noise than others depending on the following factors:

1. Morphological Factors: the shape of the leaves; the thickness of the leaves; the surface of a leaf; foliar area/plant; foliar volum/plant; biomass %; leaves and stem disposition type [17], [18].

2. Physiological Factors: light; temperature; soil type; soil permeability; humidity from the air and from the ground; the amount of O_2 and CO_2; various matters [19].

3. Plants density: number of plants / area unit; type of arrangement: solitary plants; arrangements of plants; vertical gardens [20].

4. Location:best place for absorption [20].

5. The frequency of the sound source: sound source frequencies are attenuated all the time [20]. The vegetation is a complex environment of water, soil and air, microorganisms and plants, therefore any measurements of noise levels, should take account of these parameters.

According to [7] "Laboratory Test of Sound Absorption of Vegetation" has been testing in a reverberation of sound absorption coefficient of 3 species of plants placed in pots with soil type, used with decorative role street in platband and on the streets of Europe: Viola x wittrockiana – Pansies; Primula vulgaris – primula; Buxus sempervirens – Buxus. Plants samples are given in the figure 3.

a. b. c.

Fig. 3. Plants samples: a. Pansies + Primula; b. Buxus with high density; c. Buxus with small density

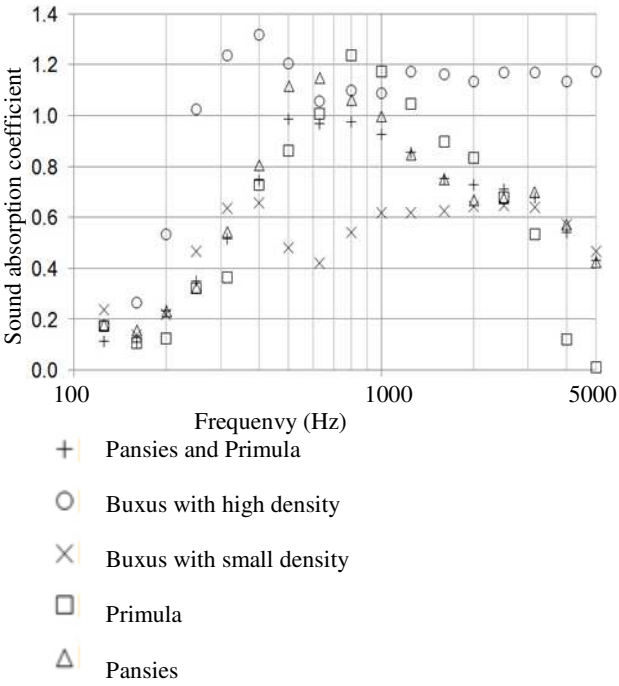

Fig. 4. Variation of absorption coefficients of studied plants

Pansies and Primula flower pots are the same 7 cm high x 10 cm diameter and 15 cm height for Buxus x 19cm have diameter, filled with the same type of soil specimens of each species were chosen so as to have the same height.

Absorption coefficient measurements were made according to ISO 11654:2005 [10], taking into account: the frequency of sound source, size and density of the plants, geometric characteristics and specific biological (Fig. 4).

It is very important to analyze the absorption for the plants, because they have the different mode to act over the sound pollution.

4. CASE STUDY

In this paper knowing the absorption coefficients for the plants: Fichus Benjamin, Howea Forsteriana, Dracaena Fragans, Spathiphyllum Wallisii, Dracaena Marginata, Schefflera Arboricola, Philodendron Scandens, The bark of the tree, Wholesale carpet, Wall gypsum – cardboard [9], [10], [11], [12], [13], [14], [15], [16].

Following the studies and measurements made were set following values for various indoor plants. The results are find centralized table 1 and are shown in Figure 5.

Table 1.

Coefficient of absorption depending on species /isolator

	Acoustic absorption coefficient					
Plants / Frequency	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**
Fichus Benjamina	0.06	0.06	0.1	0.19	0.22	0.57
Howea Forsteriana	0.21	0.11	0.09	0.22	0.11	0.08
Dracaena Fragrans	0.13	0.14	0.12	0.12	0.16	0.11
Spathiphyllum Wallisii	0.09	0.07	0.08	0.13	0.22	0.44
Dracaena Marginata	0.13	0.03	0.16	0.08	0.14	0.47
Schefflera Arboricola	0.13	0.06	0.22	0.23	0.47	0.47
Philodendron Scandens	0.23	0.22	0.29	0.34	0.72	0.72
The bark of the tree	0.05	0.16	0.26	0.46	0.73	0.88
Wholesale carpet	0.15	0.25	0.50	0.60	0.70	0.70
Wall gypsum – cardboard	0.30	0.15	0.10	0.05	0.04	0.05

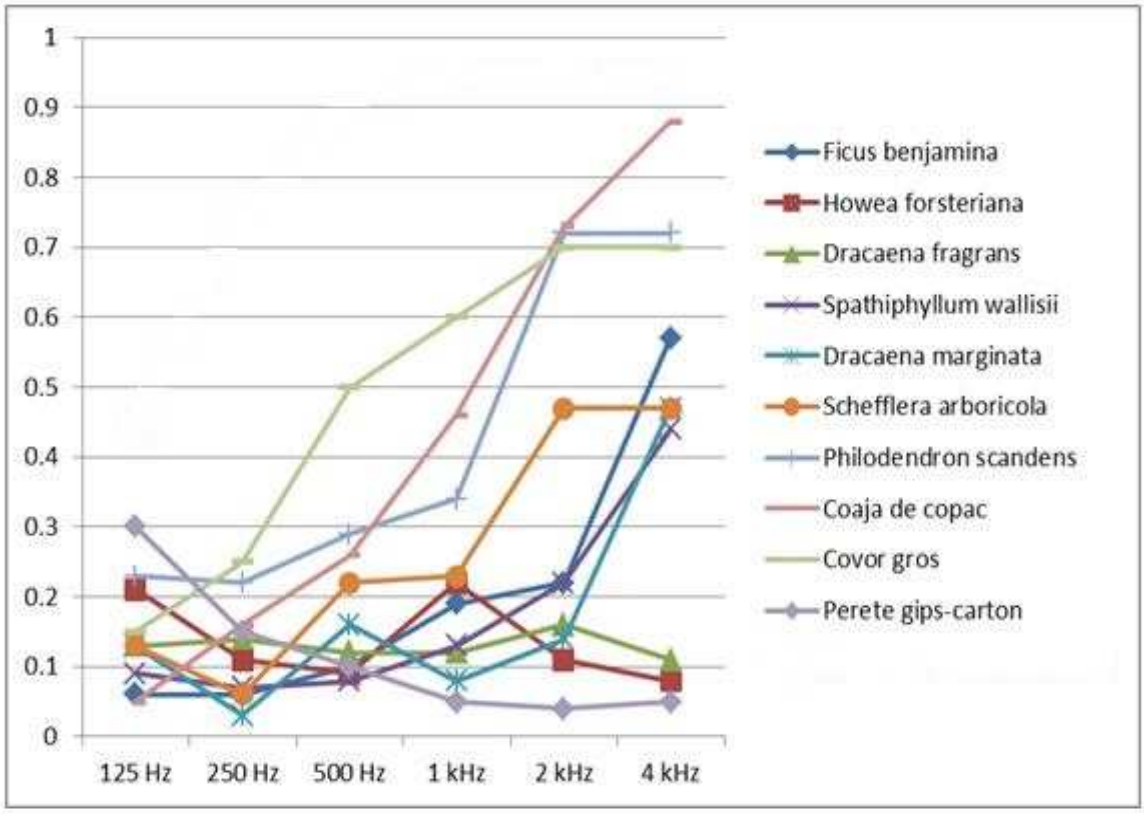

Fig. 5. Acoustic absorption coefficient graph in function of frequency for the different soundproofing materials (including plants). Soundproofing materials are: Coaja de copac = The bark of the tree; Covor gros = Wholesale carpet; Perete gips – carton = Wall gypsum – cardboard.

4. 1. Discussion about sound absorbing materials for inside

1. The highest absorption coefficient has a thick carpet followed of Philodendron Scadens a frequency of 500 Hz. Up to 2 kHz the highest coefficient is obtained from the bark of the tree, followed closely by the Philodendron Scadens.

2. Gypsum wall of 12mm thickness has a downward trend reaching over 500 Hz to be overtaken by all plants.

3. They are observed that acoustic absorption of plants increases with frequency so plants attenuate high frequencies, the most troublesome for the human ear.

4. Of the plants the best acoustic absorption has a Philodendron scandens-Filodendron, and it is a creeper plant, followed by Schefflera arboricola – it is umbrella tree or Ficus benjamina – it is Ficus bent (pendent coronae). The next is Spathiphyllum Wallisii-named Peace Lily.

5. It's interesting how the bark of the tree, i.e. also a vegetable product has an upward trajectory to the absorption coefficient, and the 2 kHz over thick carpet's race.

5. CONCLUSIONS REGARDING THE USE OF THE PLANT AS SOUND POLLUTION ATTENUATOR

Conclusions are numerous and in close connection with the factors influencing the uptake of pollution from the plant.

For the best possible sound-absorbing plants must have in terms morphological:

- a form of the leaf as close to a membrane;
- a consistent thickness of the leaf;
- the large surface of a leaf;
- the large surface of a foliar area / plant;
- foliar volume great/plant;
- % high biomass;
- leaf disposal to be radial so as to occupy the space entirely devoted;

- stem type is whatever, it does not influence the better than filling the spot intended for the plant.

All these aspects have been taken into account in experiment presented were discussed in the previous paragraph.

High density, foliage and the pervious soil divers make the soil – plant system as good collector of sound waves; plants or green wall plants is functioning as an air filter. Larger plants are more efficient than small ones, but than only a solitary plant better arrangement or even a vertical garden.

Are preferred for the edges and corners of rooms, so noise can be reflected from the walls easily intercepted by the plants.

Plants have stronger effect in strong acoustics rooms with glass walls, marble or plastic and weaker in those with thick carpeting and wood paneling.

Plants mainly high frequencies attenuate and less low ones. The species studied situated in interior of rooms, the best performances of them, they have had: Philodendron scandens, Schefflera arboricola, Ficus benjamina şi Spathiphyllum wallisii.

The general conclutions of this study can be expresed as:

1. Noise pollution affects us life gradually and is an unintended consequence and/or undervalued contemporary lifestyle.

2. Partial or total loss of hearing is considered "irreversible industrial disease the most common" by the OMS. Disease onset occurs with the loss of the ability to hear high tones.

3. Sources of noise must be first identified, limited or even eliminated so that the exposure of operators to be in line with European norms and functional standards in use.

4. Plants can reduce the noise level, from 5-12 dB, depending on several factors, presnted above.

5. Plants reduce noise, adjust the default stress, humidity in rooms to comfortable body, reduce the level of CO2, improving visual comfort and we make life prettier and quieter.

6. Environmental factors necessary to the survival of the plant premises are similar with what they want people to be able to conduct business in a sustainable environment.

7. The plants along with adequate soil should be considered a system of / for acoustic absorption.

8. At present it is considered that studies concerning absorption of noise pollution by different species of plants are perfectibile, because there are a multitude of factors that influence the final results.

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Studiu privind utilizarea regnului vegetal ca atenuator al poluării sonore

Rezumat: *Lucrarea prezintă un studiu documentar asupra utilizării regnului vegetal ca atenuator al poluării sonore. Regnul vegetal s-a dovedit în timp un bun atenuator al poluării sonore. Se caută să se găsească acele sisteme vegetale, care să producă o atenuare sonoră în mediul industrial. Această lucrare este o parte a unui studiu în ceea ce priveşte evaluarea poluării sonore în activitatea industrială.*

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