

STUDY OF PHYSICAL CHARACTERISTICS, MECHANICAL AND TECHNOLOGICAL PROPERTIES OF WOOD SPECIES FROM THE FRAXINUS GENUS ENCOUNTERED IN ROMANIA COMPARED TO OTHER MAIN FORESTRY SPECIES

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Abstract

The common ash, with its extremely valuable wood, with its remarkable potential of bioproduction and adaptation in various stations, contains as an elite tree whose expansion in culture is always welcome. (Stănescu, V., et. al, 1997). It is a tree of great value for mixed culture in meadows, in the hill mixed hardwood forest and in European beech stands, too. (Doniţă, N., et. al, 2004). Based on the importance of common ash wood, of special quality, with multiple industrial uses, we undertook this study to position it exactly in the main tree species from Romania in terms of physical characteristics and mechanical and technological properties of the wood.

Key words: common ash wood, physical characteristics, mechanical and technological properties.

INTRODUCTION

The Ash (*Fraxinus* ssp.) belongs to the Oleaceae family. There are three main autochthonous species in Europe: the common ash (*Fraxinus excelsior*), field ash (*Fraxinus angustifolia*) and flowering ash (*Fraxinus ornus*). In Romania all three native European species vegetate spontaneously, having a total surface of 60,000 ha, together with two other rare species (*Fraxinus pallisae* and *Fraxinus coriariifolia*). Usually the common ash participates in the stands as mixed species and rarely forms pure stands. We can see it in areas with rich rainfall, from field and meadow up to mountain stations of average altitude. Typical ashes are tall trees having a height of 30 m, being able to reach the maximum height of 40 m and diameter of 1 m (Doniţă N., et. al., 2004; Şofletea, N., Curtu, L., 2007), with thin branches, and the grayish-green bark being smooth in case of young trees.

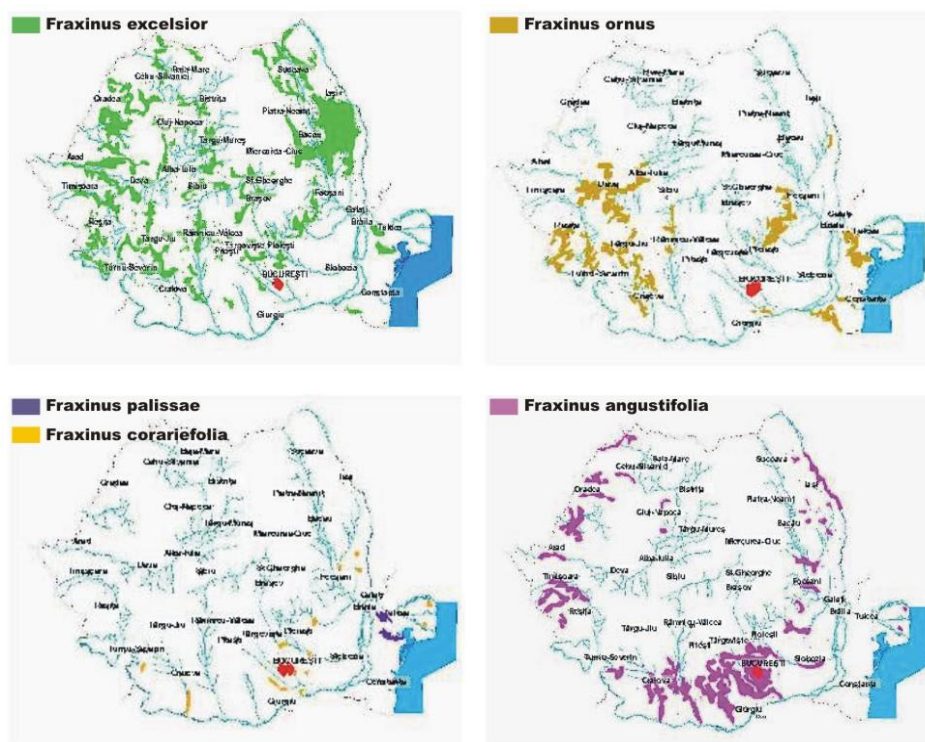


Fig. 1. The species habitat from Genus Fraxinus in Romania: Common ash (*Fraxinus excelsior*), Field ash (*Fraxinus angustifolia*), Flowering ash (*Fraxinus ornus*), Fluffy ash meadow (*Fraxinus pallisae*) and Fluffy ash hill (*Fraxinus coriariifolia*) in Romania (www.icashd.ro/fraxigen.html).

MATERIAL AND METHOD

Location in Tinca, Bihor County, period during 2010-2011.

With regards to the physical characteristics, we studied: the color of the wood, wood gloss, wood texture, and wood design.

Concerning the mechanical and technological properties, we monitored the following values: modulus of elasticity, plasticity, tensile strength, compressive strength, bending resistance to the humidity of 15%, dynamic bending resistance by striking (shock), resistance to longitudinal parallel shear, wear resistance.

RESULTS AND DISSCUSIONS

SHORT PRESENTATION OF THE MICROSCOPIC STRUCTURE OF COMMOM ASH WOOD (*FRAXINUS EXCELSIOR* L.)

Wood parenchyma circumvascular or diffuse. Vessels, 2-15 per mm²; in young wood with a frequent diameter of 250 µm (max. 350 µm); in the old wood a diameter of about 50 µm, with thick walls. Uneven fibers

regarding size, with a diameter of 27 μm . Medullar rays 1 (frequent 2-3) serial, usually with 10 cells per high. Dense round or oval intravascular punctuations.

SHORT PRESENTATION OF MACROSCOPIC STRUCTURE OF THE COMMON ASH WOOD (FRAXINUS EXCELSIOR L.)

Wood with pinkish heartwood, sometimes light brown. Wide sapwood (18-20 rings), white – yellow – pink, slightly special heartwood. From few to many matte tiles. The pores from large early wood, frequently multiple (radial groups). The pores from late wood in radial groups (2-5) with paratracheal confluent parenchyma forming uneven, wavy, more or less broken strips towards the exterior limit of the annual ring. The rays can be hardly seen with open eyes, they are white, wavy in the early wood. Polished wood, striped, strong and hard.

Color of the wood

Romanian wood species, and usually those from the temperate area, have moderate colors compared to those from hot areas. Still there are some species in our lands (native or naturalized) which have the very intense colored heartwood (oak, locust, walnut and chestnut, etc.)

By color, the ash belongs to the *bicolor wood* group, the color of the central area (heartwood – perfect wood) is different from the peripheral area (sapwood – young wood); they are also called colored wood, such as larch, yew, pine, oak, elm, ash, juniper, locust, mulberry tree, plum, etc. The heartwood is formed late, between 45 and 55 years (Filipovici, J., 1964). Forestry species from Romania usually have the following colors: white, yellow, red, brown, and gray. The ash presents the sapwood that is part of the basic white colors being white-yellowish-pink, and heartwood which is part of the basic red colors being reddish-pink (Ghelmeziu, N.G., Suciu P.N., 1959).

The ash can present the wood defect from the *stain category* – *ash brown heart* – which appears in case of standing trees; normally the ash has a pinkish heartwood up to light brown, and the *brown heart* has a dark brown color towards black. The wood from the brown heart belongs to inferior categories in comparison to the normal wood. The endurance of the wood to dynamic requests from the brown heart area is weakened.

Wood gloss

The gloss dramatically increases the beauty of a wood, consequently its value of use.

The ash belongs to the group of *wood with remarkable gloss* together with the beech, oak, maple, linden, elm, willow, alder, mulberry, hazel, etc.

Wood texture

The ash belongs to the coarse-textured wood group together with the oak, willow, elm - hardwood species with wide rays, fiber areas and very distinctive parenchyma areas.

Wood design

The ash belongs to the *group of species with patterns of longitudinal ribs* – strongly striated parallel strips of early wood, alternated with strips of smoother late wood, with fewer ribs on the radial section (species with pores placed typically in the shape of ring: oak, elm, ash, willow, chestnut).

MECHANICAL AND TECHNOLOGICAL PROPERTIES

From knowledge of the forest characteristics, a leading role is played by wood properties, especially mechanical resistance index data. To assess the mechanical and technological properties we followed the value:

- **Modulus of elasticity:** - parallel tensile – 16500 MP
- bending – 13400 MP
- torsion – 1100 MP

Based on such properties, wood is used in the industry of sports (skiing, spears, gliders, etc.) handles and the manufacture of instruments.

- **Plasticity** – ash wood has, normally, a reduced plasticity, but becomes very plastic (especially beech wood, elm, ash, oak) by applying some hydrothermal treatments or by chemical substances treatment); this characteristic stays on the basis of manufacturing curved furniture or other curved items.
- **Tensile strength** (Beldeanu, E., 2010 from Curtu, I., Ghelmeziu, N., 1984):
 - parallel fibers - 152,4
 - perpendicular to the grain: - radial – 3,7 MP
- tangential – 3,6 MP
- **Compressive strength:** - parallel fibers – 48 MP,
- perpendicular to the grain – 11 MP
- **Bending resistance to the humidity of 15%** - 105,6 MP
- **Dynamic bending resistance by striking (shock)** – together with spruce, fir, ash wood is classified as resistant group; it may be used as construction element subjected to shock and vibration (aircraft construction, sports, tails, handles for tools); this characteristic stays on the basis of manufacturing curved furniture or other curved items.
- **Resistance to longitudinal parallel shear** (Beldeanu E., 2008 from Curtu, I., Ghelmeziu, N., 1984):
 - radial – 14,9

- tangential – 15,1
- **Wear resistance** – the ash wood is classified as resistant group together with hornbeam, oak, beech, walnut, locust is only a subclass and it is very resistant. According to wear resistance, we can classify the main species in Romania, as follows: very resistant (willow), resistant (walnut, ash, oak, beech), less resistant (pine, elm, maple, willow) and with very little resistance (spruce, lime, poplar).

CONCLUSIONS

The ash wood, which has many uses, is very important for color, for its qualities of durability and elasticity. The light color makes it apt for furniture manufacturing, paneling, flooring, and interior stairs. Because of its strength and elasticity ash wood may be used in the manufacture of agricultural implements and tools. Since it is devoid of taste and smell the wood is still used in the manufacture of fruit and food bins.

Due to its flexibility ash wood is used for sports equipment. It is ideal for making items of sports equipment, especially those that require strength, flexibility and elasticity.

It was once used in skis and tennis rackets, and now, in rowing, baseball bats, hockey sticks, billiard cues, bows and arrows, sled dog racing and many other such uses.

It would be interesting to study the wood of field ash (*Fraxinus angustifolia*), which has softer wood than the common ash, often affected by the color of the heartwood and even by the rotting of wood on the leg from a young age, from 35-40 years. The cause could be the ecological conditions due to the stationed wet environment, this species vegetating in the interior valleys of rivers from Romania, on hydromorphic soils. The common ash vegetates very well in these stationary conditions, being less affected by staining and rotting of wood; it presents mechanical and technological properties of field ash wood. Foresters should think about the introduction and maintaining of common ash in meadow resorts.

The common ash (*Fraxinus excelsior*) which lives in Romania grows relatively fast and produces very valuable wood for the furniture industry. Some species of common ash, as well as some mountain maples, present kale wood fiber, belonging to the category of species with special value from the aesthetic point of view. Lately the ash wood has been more and more appreciated in the industry of wood manufacturing, having multiple uses due to its remarkable properties.

Due to the slender torso well complied with the proportion of working, the wood ash is high. Common ash is one of the leading forest species in Romania.

REFERENCES

1. Beldeanu, E., 1999 – Produse forestiere și studiul lemnului. Editura Universității "Transilvania", Brașov, 362 p.
2. Beldeanu, E., 2008 - Produse forestiere, Editura Universității "Transilvania" din Brașov, 331 p.
3. Curtu, I., Ghelmeziu, N., 1984 – Mecanica lemnului și materialelor pe bază de lemn. Ed. Didactică și Pedagogică, București, 1984.
4. Ciocârlan, V., 2000. Flora ilustrată a României. Editura Ceres, București.
5. Doniță, N., Chiriță, C., Stănescu, V. și colab. 1990. Tipuri de ecosisteme din România. C.M.D.P.A., I.C.A.S., București.
6. Doniță, N., Geambașu, T., Brad R., 2004 – Dendrologie. "Vasile Goldiș" University Press, Arad.
7. Doniță, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S., Biriș, I., 2005. Habitatele din România. Editura Tehnică Silvică, București.
8. Florescu, I., Nicolescu, N., 1996, 1998. Silvicultura. Editura Lux Libris, Brașov, 210+194p.
9. Florescu, Gh., Abrudan, I. V., 1998. Împăduriri. Principii și soluții de proiectare. Editura Universității Transilvania, Brașov.
10. Florescu, I., Abrudan, I. V., 2003. Tehnologii de instalare a culturilor forestiere. Editura Universității Transilvania, Brașov.
11. Filipovici, J., 1964 – Studiul lemnului. Vol. I, Edit. Didactică și Pedagogică, București.
12. Filipovici, J., 1965 – Studiul lemnului. Vol. II, Edit. Didactică și Pedagogică, București 620 p.
13. Ghelmeziu, N.G., Suci P.N., 1959 - Identificarea lemnului. Edit. Tehnică București, 397 p.
14. Moțiu, P.T., 2004. Caracteristici dendrometrice ale unor specii alohtone cultivate în O.S.Tinca, Jud. Bihor. Analele Universității din Oradea, Fascicula Silvicultură, pg.135-144.
15. Negulescu, E., Stănescu, V., Florescu, I., Târziu, D. 1973. Silvicultura I, II. Ed. Ceres, București.
16. Stănescu, V., Șofletea, N., Popescu, O., 1997 – Flora forestieră lemnoasă a României. Editura Ceres, București, 451 p.
17. Șofletea, N., Curtu, L., 2007 – Dendrologie, Editura Universității "Transilvania" din Brașov, 418 p.
18. Tătăranu, D., Costea, A., Hulea, A., Mihalache, A., Milea, I., Pătrășcoiu, N., Petrescu, M., Tocan, M., Stoiculescu, Cr., Voicescu, I., 1988. Compatibilitatea ecologică și silvoprodusivă a unor specii lemnoase exotice în R.S. România. Zone de cultură. Redacția de Propagandă tehnică agricolă, București, p. 114.
19. Târziu, D. R., 2006. Pedologie și stațiuni forestiere. Editura Silvodel, Brașov.
20. www.icashd.ro/fraxigen.html.