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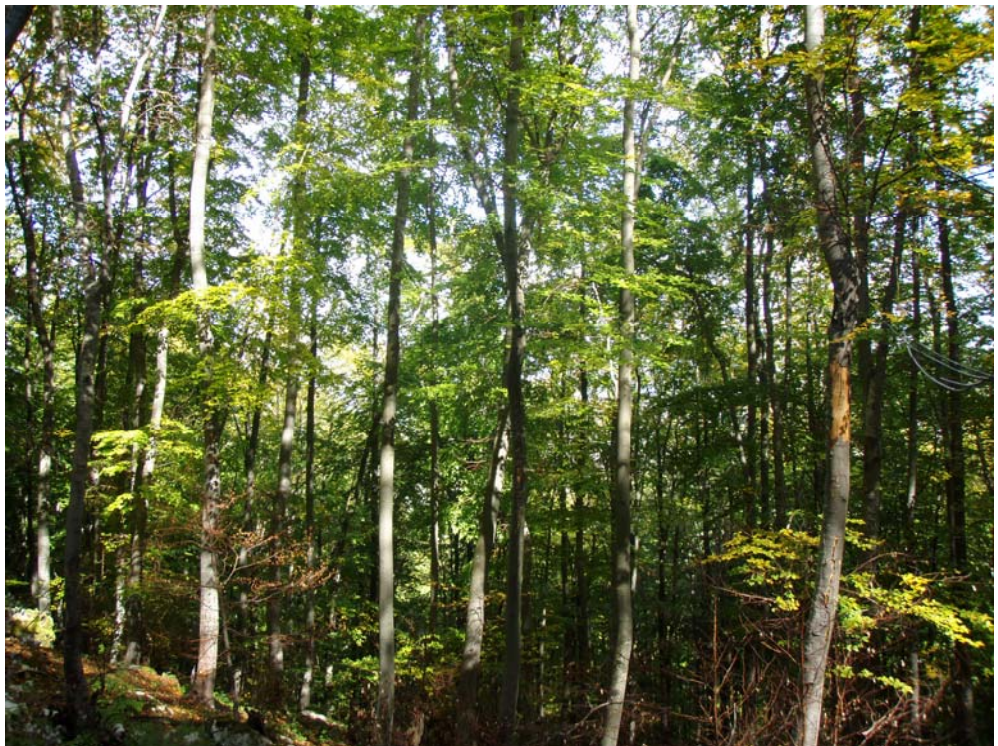


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**SUSTAINABLE FORESTRY    ODRŽIVO ŠUMARSTVO**

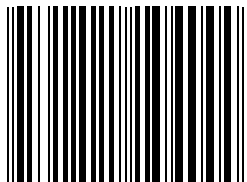
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**REFLECTION OF DIFFERENT FINANCING MECHANISMS WITHIN THE**

**NATIONAL PARK "FRUŠKA GORA"**

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159

UDK 001.8 : 004.738.5 : 630\*176.1 Fraxinus ornus L.=111

Review paper

## EXPLORATION OF *FRAXINUS ORNUS* L. BIBLIOGRAPHIC DATA USING PRINCIPAL COMPONENT ANALYSIS (PCA)

Srđan BOJOVIĆ<sup>1</sup>, Biljana NIKOLIĆ<sup>2</sup>,  
Slobodanka MITROVIĆ<sup>3</sup>, Petar D. MARIN<sup>4</sup>

**Abstract:** *Bibliographic data of manna ash were analyzed in order to find out at the first sight the direction of the research on the species which would serve as the model for further investigations on different plant species. By finding out the direction of the previous researches, it becomes easier for us to select the direction of the future ones. By using references from the data base "Scopus" obtained in the last ten years we noted the frequency of the key words for domains of research. PCA analysis showed that the previous researches conducted on Fraxinus ornus were mainly aimed at the studies of the ecological aspect, chemical composition and stress and to a lesser extent at genetic variability and hybridization. We suggest more genetic investigations of this species in the future.*

**Key words:** Flowering ash, crni jasen, PCA, references, data records, genetics

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# ISTRAŽIVANJE BIBLIOGRAFSKIH PODATAKA ZA (PCA)

**Izvod:** Bibliografski podaci o crnom jasenu su analizirani sa ciljem da se na prvi pogled uoči pravac istraživanja vrste, kako bi mogao poslužiti kao model za buduća istraživanja na različitim biljnim vrstama. Na osnovu utvđenog pravca prethodnih istraživanja postaje nam lakše da izaberemo pravac budućih. Koristeći reference iz baze podataka "Scopus" za poslednjih deset godina ustanovili smo frekvencije ključnih reči po oblastima istraživanja. PCA analiza je pokazala da su se prethodna istraživanja *Fraxinus ornus* uglavnom odnosila na proučavanja sa aspekta ekologije, hemijskog sastava i stresa, a u manjem obimu na proučavanje genetičke varijabilnost i hibridizacije. Sugerišemo više genetičkih istraživanja na ovoj vrsti u budućnosti.

**Ključne reči:** Flowering ash, crni jasen, PCA, reference, podaci, genetika

## 1. INTRODUCTION

To make progress in research, the first step is bibliographics data searching. The bibliographics data are generally very extensive, and in them is not easy to find the basic guidelines of the research. Researchers need to be familiar with the research already being conducted within different areas as well as current research gaps. Based on this information (e.g. from journals), deficits in our research area can be identified and directed.

It is possible to analyse datasets by different multivariate methods, traying to identify sources of variability and groupings in the data. Theoretical base of PCA is very well known (Krzanowski, 1988; Falissard, 2005, etc.). Multivariate methods, especially PCA were very often used in investigation of diversity and taxonomy of plants (Dodd et al., 1993; Bojović et al., 2000a, 2005; Slavkovska et al., 2001; Nikolić et al., 2007, 2008, 2009; Kapetanios et al., 2008, etc).

## 2. MATERIAL AND METHODS

Bibliographic references of *Fraxinus ornus*, obtained from "Scopus" data base during the past ten years (2008-1999), were summarized by keywords in different areas of research.

In processing data by Principal component analysis (PCA) (factors: a – areas of research; b – bibliographic references) we used statistical program "Statoscope".

### 3. RESULTS AND DISCUSSION

We defined 17 areas of research as following (a1-a17):

- (a1) Chemical composition
- (a2) Wood properties
- (a3) Pollen characteristics
- (a4) Stress
- (a5) Anatomy
- (a6) Pests and diseases
- (a7) Adaptability
- (a8) Reforestation
- (a9) Ethnobotany
- (a10) Sexuality
- (a11) Genetic variability
- (a12) Physiology
- (a13) Hybridization
- (a14) Ecology
- (a15) Climate change
- (a16) Morphology and
- (a17) Seed properties

Obtained bibliographic references (cca 31) of *Fraxinus ornus* L. were signed as following:

(b1)

De Micco, V., Aronne, G. i Baas, P. (2008). Wood anatomy and hydraulic architecture of stems and twigs of some Mediterranean trees and shrubs along a mesic-xeric gradient. *Trees - Structure and Function*, 22(5), 643-655.

(b2)

Primorac, L., Bubalo, D., Kenjeric, D., Flanjak, I., Pirički, A.P. i Mandić, M.L. (2008). Pollen spectrum and physicochemical characteristics of Croatian Mediterranean multifloral honeys. *Deutsche Lebensmittel-Rundschau* 104(4), 170-175.

(b3)

De Micco, V. i Aronne, G. (2007). Combined histochemistry and autofluorescence for identifying lignin distribution in cell walls. *Biotechnic and Histochemistry*, 82(4-5), 209-216.

(b4)

Chiatante, D., Scippa, G.S., Iorio, A.D., De Micco, V. i Sarnataro, M. (2007). Lateral root emission in woody taproots of *Fraxinus ornus* L. *Plant Biosystems*, 141(2), 204-213.

(b5)

Ma, J. i Zhang, X.-G. (2007). Two new species of *Sporidesmium* from Yunnan, China. *Mycotaxon*, 101, 73-76.

(b6)

Muzzi, E. i Fabbri, T. (2007). Revegetation of mineral clay soils: Shrub and tree species compared. *Land Degradation and Development*, 18(4), 441-451.

(b7)

Kültür, S. (2007). Medicinal plants used in Kirklareli Province (Turkey). *Journal of Ethnopharmacology*, 111(4), 341-364.

(b8)

Verdú, M., Spanos, K., Čaňová, I., Slobodník, B. i Paule, L. (2007). Similar gender dimorphism in the costs of reproduction across the geographic range of *Fraxinus ornus*. *Annals of Botany*, 99(1), 183-191.

(b9)

Španjol, Ž., Barčić, D., Rosavec, R. i Ugarković, D. (2006). Ameliorative role of Aleppo pine (*Pinus halepensis* Mill.) in the regeneration of climatozonal vegetation. *Periodicum Biologorum*, 108(6), 655-662.

(b10)

Verdú, M., González-Martínez, S.C., Montilla, A.I., Mateu, I. i Pannell, J.R. (2006). Ovule discounting in an outcrossing, cryptically dioecious tree. *Evolution*, 60(10), 2056-2063.

(b11)

Solymsi, K. i Böddi, B. (2006). Optical properties of bud scales and protochlorophyll (ide) forms in leaf primordia of closed and opened buds. *Tree Physiology*, 26(8), 1075-1085.

(b12)

Heuertz, M., Carnevale, S., Fineschi, S., Sebastiani, F., Hausman, J.F., Paule, L. i Vendramin, G.G. (2006). Chloroplast DNA phylogeography of

European ashes, *Fraxinus* sp. (Oleaceae): Roles of hybridization and life history traits. *Molecular Ecology*, 15 (8), 2131-2140.

(b13)

De Mei, M. i Di Mauro, M. (2006). Study of some characteristic Mediterranean vegetation species best suited for renaturalization of terminal-phase municipal solid waste (MSW) landfills in Puglia (Southern Italy). *Acta Oecologica*, 30(1), 78-87.

(b14)

Chiatante, D., Iorio, A. D., Sciandra, S., Scippa, G. S. i Mazzoleni, S. (2006). Effect of drought and fire on root development in *Quercus pubescens* Willd. and *Fraxinus ornus* L. seedlings. *Environmental and Experimental Botany*, 56(2), 190-197.

(b15)

D'Alessandro, C. M., Saracino, A. i Borghetti, M. (2006). Thinning affects water use efficiency of hardwood saplings naturally recruited in a *Pinus radiata* D. Don plantation. *Forest Ecology and Management*, 222(1-3), 116-122.

(b16)

Verdú, M., Montilla, A. I. i Pannell, J. R. (2004). Paternal effects on functional gender account for cryptic dioecy in a perennial plant. In *Proceedings of the Royal Society (B: Biological Sciences 271)*, London, 2017-2023.

(b17)

Takos, I. A. i Efthimiou, G. S. (2003). Germination results on dormant seeds of fifteen tree species autumn sown in a Northern Greek nursery. *Silvae Genetica*, 52(2), 67-71.

(b18)

Nardini, A., Salleo, S., Trifilò, P. i Lo Gullo, M. A. (2003). Water relations and hydraulic characteristics of three woody species co-occurring in the same habitat. *Annals of Forest Science*, 60(4), 297-305.

(b19)

Chiatante, D., Sarnataro, M., Fusco, S., Di Iorio, A. i Scippa, G. S. (2003). Modification of root morphological parameters and root architecture in seedlings of *Fraxinus ornus* L. and *Spartium junceum* L. growing on slopes. *Plant Biosystems*, 137(1), 47-55.

(b20)

Kalapos, T. i Csontos, P. (2003). Variation in leaf structure and function of the Mediterranean tree *Fraxinus ornus* L. growing in ecologically contrasting habitats at the margin of its range. *Plant Biosystems*, 137(1), 73-82.

(b21)

Iossifova, T., Vogler, B. i Kostova, I. (2002). Escuside, a new coumarin-secoiridoid from *Fraxinus ornus* bark. *Fitoterapia*, 73(5), 386-389.

(b22)

Oddo, E., Saiano, F., Alonzo, G. i Bellini, E. (2002). An investigation of the seasonal pattern of mannitol content in deciduous and evergreen species of the Oleaceae growing in northern Sicily. *Annals of Botany*, 90(2), 239-243.

(b23)

Oddo, E., Sajeva, M. i Bellini, E. (2002). Seasonal pattern of mannitol and malate accumulation in leaves of two manna ash species (*Fraxinus ornus* L. and *F. angustifolia* Vahl) growing in Sicily. *Plant Biosystems*, 136(1), 29-34.

(b24)

Kostova, I. (2001). *Fraxinus ornus* L. *Fitoterapia*, 72(5), 471-480.

(b25)

Radoglou, K. i Raftoyannis, Y. (2001). Effects of desiccation and freezing on vitality and field performance of broadleaved tree species. *Annals of Forest Science*, 58(1), 59-68.

(b26)

Piasentier, E., Bovolenta, S. i Malossini, F. (2000). The *n*-alkane concentrations in buds and leaves of browsed broadleaf trees. *Journal of Agricultural Science*, 135(3), 311-320.

(b27)

Tognetti, R., Cherubini, P. i Innes, J. L. (2000). Comparative stem-growth rates of Mediterranean trees under background and naturally enhanced ambient CO<sub>2</sub> concentrations. *New Phytologist*, 146(1), 59-74.

(b28)

Guarrera, P. M. (1999). Traditional antihelmintic, antiparasitic and repellent uses of plants in Central Italy. *Journal of Ethnopharmacology*, 68(1-3), 183-192.

(b29)

Dommée, B., Geslot, A., Thompson, J. D., Reille, M. i Denelle, N. (1999). Androdioecy in the entomophilous tree *Fraxinus ornus* (Oleaceae). *New Phytologist*, 143(2), 419-426.

(b30)

Tognetti, R., Longobucco, A. i Raschi, A. (1999). Seasonal embolism and xylem vulnerability in deciduous and evergreen mediterranean trees influenced by proximity to a carbon dioxide spring. *Tree Physiology*, 19(4-5), 271-277.

(b31)

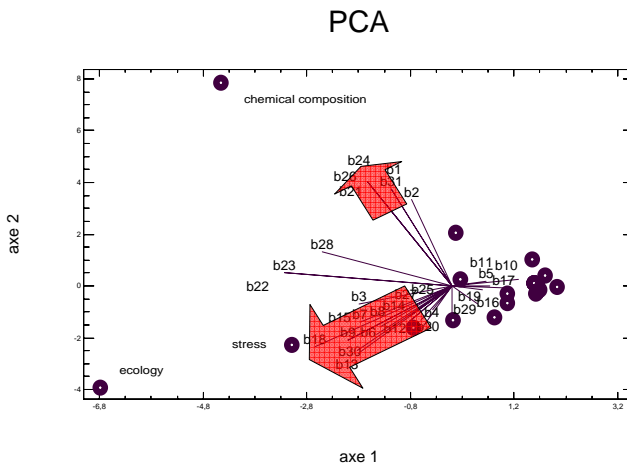
Iossifova, T., Vogler, B., Klaiber, I., Kostova, I. i Kraus, W. (1999). Caffeic acid esters of phenylethanoid glycosides from *Fraxinus ornus* bark. *Phytochemistry*, 50(2), 297-301.

In the multivariate statistical analysis (PCA, see Graph 1) we regarded the bibliografic references as characteristics, and domains as elements (the columns) and concluded that

(1) the reseaches of the ecological aspect, chemical composition and stress were the most distinctive and that

(2) the biggest group of the journals (to which the largest number of the leading international journals also belong) have focused their attention on ecology (biogeography) and stress.

**Graph 1.** Graphical vizualization of PCA results in the plan of the first two axes: 31 bibliographics data (b1-b31) refers to 17 area of research. ● - Area of research

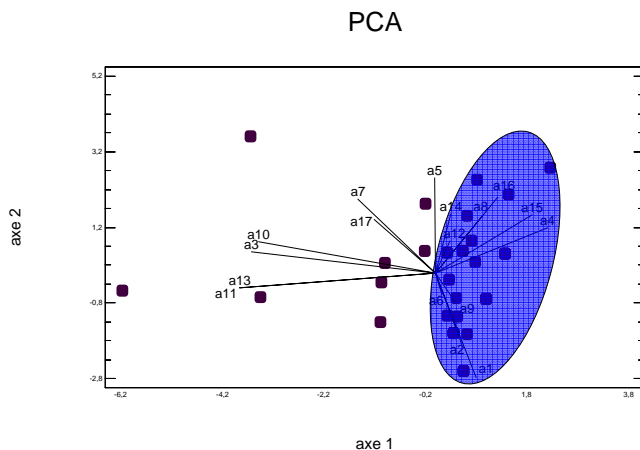


Reversely, when the bibliographic references were regarded as elements (rows), and the domains as characteristics, we found situation presented in Graph 2, and concluded that

(3) the most pieces of information on *Fraxinus ornus* were obtained from “hunger information“ on the genetic variability and hybridization and that

(4) the most papers (>50%) were from the domain of ecology (biogeography), chemical composition and stress.

**Graph 2.** Graphical vizualization of PCA results in the plan of the first two axes: 17 area of research (a1-a17): (a1) Chemical composition, (a2) Wood properties, (a3) Pollen characteristics, (a4) Stress, (a5) Anatomy, (a6) Pests and Diseases, (a7) Adaptability, (a8) Reforestation, (a9) Etnobotany, (a10) Sexuality, (a11) Genetic variability, (a12) Physiology, (a13) Hybridization, (a14) Ecology, (a15) Climate change, (a16) Morphology and (a17) Seed properties, refer to 31 bibliographics data. ■ – Bibliographics data



Relatively small number of references about flowering ash were found in the "Scopus" data base in the last ten years. Additional references could be also found in some national journals, project reports, proceedings or for some older sources (Bojović et al. 1997, 1998, 1999, 2000b,c, 2003, etc.), as well as from other data bases (Wallander, 2008). It seems that it was the same situation with references of *Fraxinus excelsior* L. and *Fraxinus angustifolia* Vahl. from the same data base in the last ten years. Large number of references in the group of fields of genetics, ecology, sistematics and evolution (at least 17 and 10, respectively) were found (references were not presented).

## 4. CONCLUSION

Relatively small number of references with *Fraxinus ornus* were published in the last ten years. On the other hand, some more were not very well known as they had been published in journals or other sources of lesser international significance. According to results of PCA we recommend the researches of flowering ash towards studying of its genetic variability and hybridization in the future since they were scarce in the last period. Furthermore, the researches could be directed towards a domain which had not been the object of study so far.

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# EXPLORATION OF *FRAXINUS ORNUS* L. BIBLIOGRAPHIC DATA USING PRINCIPAL COMPONENT ANALYSIS (PCA)

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## Summary

Researchers need to be familiar with the research already being conducted within different areas as well as current research gaps. Based on this information (e.g. from journals), deficits in our research area can be identified and directed. The aim of this paper is to find out the direction of the previous researches and the possible direction of the future researches on *Fraxinus ornus* L. more easily and quickly. In the "Scopus" data base 31 bibliographic references about flowering ash in the past ten years were reported. According to their keywords they were grouped in 17 research areas and analyzed by multivariate statistical method PCA. On the base of the obtained results it was concluded that: (1) the researches of the ecological aspect, chemical composition and stress were most distinctive, (2) the biggest group of the journals focused their attention on ecology (biogeography) and stress, (3) the most pieces of information on *Fraxinus ornus* were obtained from "hunger information" on the genetic variability and hybridization, and that (4) over 50% of papers are from the domain of ecology (biogeography), chemical composition and stress. Obviously, some articles or reports about flowering ash are not always available because they were published in different literature sources of lesser international significance. According to results of PCA we recommend the researches of flowering ash towards studying of its genetic variability and hybridization in the future since they were scarce in the last period. Furthermore, the researches with *Fraxinus ornus* could be directed towards a domain which had not been the object of study so far.

# ISTRAŽIVANJE BIBLIOGRAFSKIH PODATAKA ZA *FRAXINUS ORNUS* L. PUTEM ANALIZE GLAVNIH KOMPONENTI (PCA)

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## Rezime

Istraživači bi trebalo da budu upoznati kako sa već obavljenim istraživanjima u različitim oblastima tako i sa trendovima u istraživanjima. Na osnovu tih informacija (iz časopisa, na primer) nedostaci u našem polju istraživanja se mogu identifikovati i usmeriti. Cilj ovog rada je da se što lakše i brže odredi pravac prethodnih i mogući pravac budućih istraživanja kod *Fraxinus ornus* L. U bazi podataka "Scopus" u poslednjih deset godina nalazi se 31 bibliografska referenca o crnom jasenu. Prema ključnim rečima one su grupisane u 17 polja istraživanja i analizirane multivarijacionom statističkom metodom PCA. Na osnovu dobijenih rezultata zaključeno je: (1) da se

najviše razlikuju istraživanja ekologije, hemijskog sastava i stresa, (2) da je najveća grupa časopisa usmerila svoju pažnju ka ekologiji (biogeografiji) i stresu, (3) da je najveći deo informacija dobijen na osnovu nedostajućih podataka za genetsku varijabilnost i hibridizaciju i da (4) preko 50% članaka je iz oblasti ekologije (biogeografije), hemijskog sastava i stresa. Očigledno je i da neki članci ili saopštenja o crnom jasenu nisu uvek dostupni jer su publikovani u različitim literaturnim izvorima manjeg međunarodnog značaja. Na osnovu rezultata PCA preporučujemo buduća istraživanja crnog jasena u pravcu proučavanja njegove genetičke varijabilnosti i hibridizacije, jer su ona u poslednje vreme bila oskudna. Istraživanja *Fraxinus ornus* bi se, takođe, mogla usmeriti i u do sada neistražena područja proučavanja.

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