USING THE ANALYTICAL HIERARCHY PROCESS IN SELECTING THE MOST IMPORTANT NON-WOOD FOREST PRODUCTS FROM OLT COUNTY

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ABSTRACT

The present paper analyses the main non-wood forest products (NWFP) from Olt County based on an analytical hierarchy process (AHP) and a specialised decision-making software. The first part mentions the main characteristics of the forest fund from Olt County, followed by the identification of the main non-wood products. The research continues with defining and explaining the analytical hierarchy process and then establishing the categories of non-wood products used in the analysis. In addition, the analysis method for the selected criteria and established non-wood products is also presented. They are eight in total and belong to the following categories: mushrooms, tree and plant products and animal origin products. The results present the most important non-wood products from Olt County based on the realized analysis and discussing their main criteria as their strong or weak points. Based on the AHP results, the most important NWFPs products from this county are Acacia honey and penny bun (Boletus edulis), while the least important ones are peppermint (Mentha piperita) and common nettle (Urtica dioica).

INTRODUCTION

Situated in South Romania, Olt County (Fig. 1) has a forest surface of 58.824 ha, representing approximately 10% of the county's surface. This numbers place the county on the 22nd place in Romania in regard with forest coverage. An average of 0,13 ha/inhabitant results for the year 2014 by reporting the forest surface to the total number of inhabitants. This number can be compared with the average national (0.26 h/inhabitant) and with the European average (0,33 h/inhabitant) (http://apmot.anpm.ro). Olt County Forest Administration manages currently a surface of 30871 ha public state forest property whose management is realized through six forest districts (Balş, Caracal, Corabia, Draganeşti, Slatina and Vultureşti), 21 forest areas and 119 forest ranges (www.rosilva.ro).

According to the United Nations *Food and Agriculture Organization* (FAO), Non-Wood Forest Products (NWFP) are products of biological origin other than wood, obtained from forests, wooded land and trees located outside the forests. NWFPs include products used as food (nuts, fruits, mushrooms, herbs, plants, game), fibres (used for construction, clothing, furniture), gums, resins, or plant and animal products used for cosmetic, medicinal or cultural purposes (Man and Funar, 2011).

Regarding NWFP in Romania, research in this field were made for different categories and especially taking into consideration the forest found managed by RNP ROMSILVA. Thus, in 2016, Vasile Diana et al. addressed the issue of harvesting medicinal plants from the spontaneous flora of the forest fund administered by RNP Romsilva (Vasile et al., 2016) and that of harvesting the forest fruits from the same forest fund (Vasile et al., 2016b). Also, the impact of collecting mushrooms from the spontaneous flora on forest ecosystems in Romania was studied some years ago (Vasile et al., 2017).

The aim of this study was to highlight the most important non-wood forest products from Olt County.
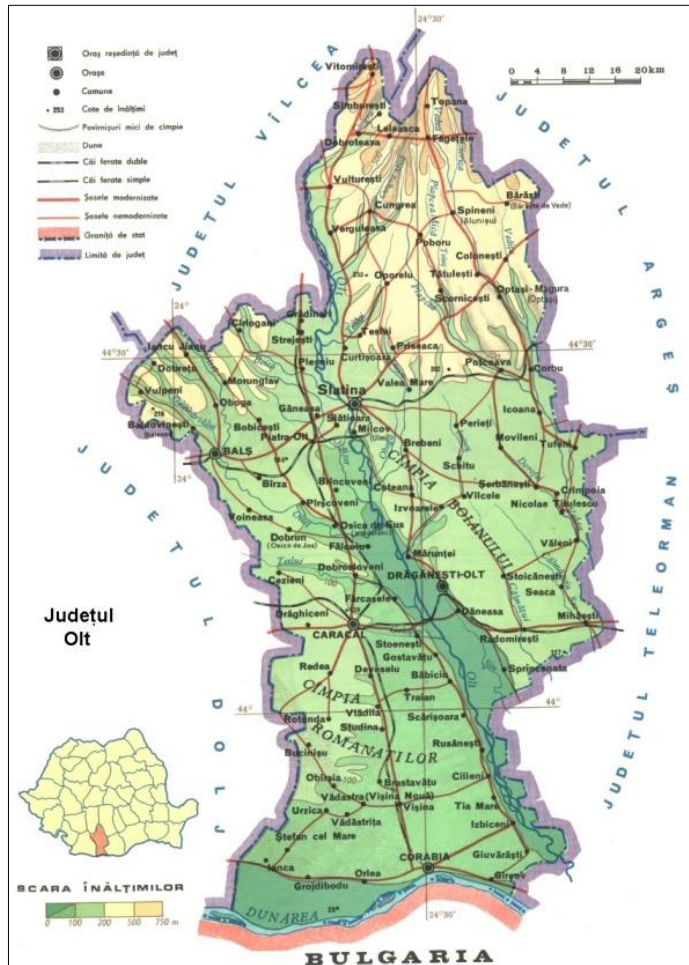
Figure 1. Location of Olt County (Source: www.peharta.ro)

MATERIAL AND METHODS

An analytical hierarchy process (AHP) was used in order to determine the most important NWFPs products from Olt County. AHP is a technique for analysing and organizing complex decisions, based on psychology and mathematics (Saaty,

2008). The method was developed by Thomas L. Saaty in the 1970s and it represents the most accurate approach for quantifying the criteria weights. The method uses the experience of individual experts in order to estimate the relative magnitudes of factors through pair-wise comparisons (https://en.wikipedia.org /wiki/Analytic_hierarchy_process).

In our case, the studied NWFPs were grouped in the following four categories: *Mushrooms*, *Tree products, Understory plants,* and *Animal* origin. The most important NWFPs were then selected by using the above-mentioned data.

The four categories were designed and used for research in the COST Action FP1203 European project. In Romania, the method was also used in similar studies recently conducted for Maramures (Enescu et al., 2017), Timis (Enescu et al., 2018), Bihor (Timiș-Gânsac et al., 2018) Prahova (Enescu et al., 2018) and Dolj (Cântar et al., 2018).

Nineteen criteria were taken into account in order to obtain the AHP analysis regarding the for NWFP categories (Table 1). Each NWFP was then studied based on these criteria and has obtained a grade from 1 to 8 for each one.

The Expert Choice Desktop software package (v. 11.5.1683) was used for centralizing the data.

RESULTS AND DISCUSSIONS

The NWFPs selected from each category were the following: penny bun (*Boletus edulis*) and parasol mushroom (*Macrolepiota procera* (Scop.) Singer) for the *Mushrooms* category, acorn (*Quercus* spp.) for the *Tree products* category, raspberry (*Rubus idaeus)*, common nettle *(Urtica dioica)* and peppermint (*Mentha piperita)* for the *Understory plants* category and *Acacia honey* and muflon (*Ovis musimon*) for the *Animal origin* category.

Based on the AHP results, the most important NWFPs from Olt county are Acacia honey and penny bun (*Boletus edulis*), while the least important ones are peppermint (*Mentha piperita)* and common nettle *(Urtica dioica)* (Fig. 2).
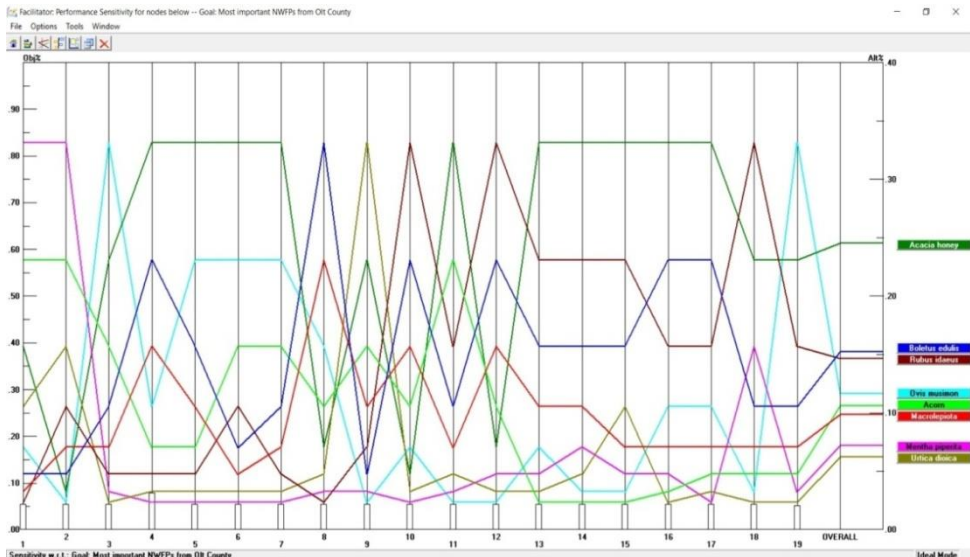
Figure 2. The ranking of the eight NWFPs

The grading of the above-mentioned NWFPs based on each of the 19 criteria is rendered in Table number 1.

<div align="right">Table 1</div>

<div align="center">AHP alternative ranking</div>

Criterion	Mushrooms		Tree products	Understory plants			Animal origin	
	Boletus edulis	Macrolepiota procera	Acorn	Rubus idaeus	Urtica dioica	Mentha piperita	Acacia honey	Ovis aries
Harvesting period	4	2	7	1	5	8	6	4
Portfolio of derived products	3	4	7	5	6	8	2	1
Harvested quantity / worker / 8 hours	5	4	6	3	1	2	7	8
Harvesting cost	7	6	4	3	2	1	8	5
Knowledge for recognition	6	5	4	3	2	1	8	7
Knowledge for harvesting	4	3	6	5	2	1	8	7
Tools needed for harvesting	5	4	6	3	2	1	8	7
Complexity of harvesting process	8	7	5	1	3	2	4	6
Distribution range	3	5	6	4	8	2	7	1
Market potential	7	6	5	8	2	1	3	4
The price of raw product	5	4	7	6	3	2	8	1
The price of the derived product	7	6	5	8	2	3	4	1
Transport (harvesting - storage centre)	6	5	1	7	2	3	8	4
Perishability	6	5	1	7	3	4	8	2
"Celebrity" of the product on market	6	4	1	7	5	3	8	2
Market demand	7	4	2	6	1	3	8	5
Biotic threats	7	4	3	6	2	1	8	5
Abiotic threats	5	4	3	8	1	6	7	2
Development of harvesting process	5	4	3	6	1	2	7	8

Based on these results, Acacia honey has a low harvesting cost and a high price of raw products. The species has obtained very good grades for over half of

the considered criteria, with the exception of derived products portfolio, complexity of harvesting process, market potential and the price of derived products.

For the mushroom category, penny bun (*Boletus edulis*) is situated in the top, having a low harvesting cost, low complexity of harvesting process, a good marketing potential, low biotic and abiotic threats and a high price of derived products.

Acorn occupies a middle place in the NWFP classification but we consider that its future importance will be high. This forecast is consolidated by the fact that acornsrarely fructify, at intervals of 5-6 years, while the need for reintroducing these species in deforests fields from South Romania or even in the forest fund is high.

CONCLUSIONS

Taking into account the fact that the county's forest surface is reduced in comparison with the national average, the importance of NWFPs from Olt County is not very significant. However, if we take into account the protection function of the existent forests and the presence of some important natural reservations located here, NWFPs can represent an important economic alternative for capitalizing wood mass.

Harvesting and selling NWFPs represents an important income source both for forest managers as well as owners.

The present study and its results represent an important contribution in regard with the general potential of NWFPs as well as for the ones located in this county.

The used software, Expert Choise Desktop, combined with AHP proved to be an easy tool to use for solving complex decision-making problems. Obtaining more representative data might require the analysis of additional criteria and including certain specialists or people that are involved in multiple domains related with the analysed products.

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REALIZATION OF THE FIRST STAGES OF THE SCHEME OF THE CLONAL SELECTION AT THE VARIETIES *VICTORIA* AND *CANNER*

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ABSTRACT

This paper presents the realization of the first stages of the Clonal Selection Scheme and obtaining valuable clonal selections: the selections in the populations of the varieties and the multiplication of two important clonal elites through the superior qualitative traits regarding the technological potential.

Two clonal elites of the Victoria and Canner varieties were selected from the production plantations, known for their high qualities. It was pursued, through the selection activity, to obtain a clonal elite from the respective varieties, selections that would be superior to the population.

Thus were obtained the selections Victoria 3-2-3 and Canner 35-2-1, which surpassed the varieties selected by weight of grapes and grains. It can be stated at the same time that the two varieties transmit in the vegetative descendants valuable characters, resulted through the process of improvement.

INTRODUCTION

In any process of improvement, the efficiency of the selection is conditioned by the variability of the material with which it is worked, by the degree of heritability of the characters and characteristics of the respective germplasm and by the chance of the breeder to be able to detect the copies corresponding to the objectives pursued. Because, by selection, no new forms are created, but only valuable specimens are retained, the success of the selection depends on the limits of genotypic variability existing within the germplasm. The different weight of genotypic variations and those determined by the environmental conditions depends largely on the way the plants reproduce (C. N. Leonte, 2011).

The precise knowledge of the determinants of the natural selection (climatic, edaphic, biotic) and their mode of action is obligatory for the breeder otherwise it cannot be used by the positive action, of the natural selection, it cannot be included in the selection activity, which he exercises it (M.I. Neagu, 1975).

Vegetative reproduction preserves the genetic structure (heterozygous or homozygous), as a result, all individuals belonging to a clone (offspring resulting from vegetative multiplication of a single individual) are genetically identical. A species with vegetative reproduction is made up of populations of biotypes or clones. The diversity of genotypes appears as a result of the mugural variations caused by

gene mutations, crossing over somatic and some changes in chromosome structure. It means that by choosing and cloning a part or an entire plant possessing individual characteristics useful economically, adaptively, structurally, ornamentally, the separation from the original population of a clone that can lay the foundation for the development of a new variety is achieved (T. Crăciun, 1981).

MATERIAL AND METHODS

Observations, determinations, analysis regarding the clonal elites from the experiments were individually recorded on the plant, except for the phenological observations and the phytosanitary status.

Phenological observations - the calendar data for the phases of the vegetative organs are recorded: bleeding (10% of the buds on the wine plant); bud burst; start of flowering, beginning of berry ripening, full physiological maturity of the berry, falling leaves.

Determinations made during the vegetation period on the elite and witness variety: the loading of the buds per plant, the number of viable buds on each plant, percentage of dead buds, numărul de lăstari (total și fertil), number of inflorescences per plant, number of bunches per plant, the average weight of a bunch, the average weight of a berry, production of grapes per plant.

The dry substance (refractometric) content of the fruits at harvest: the content of the must in sugars g/l; acidity g/l H_2SO_4.

Varieties subject to clonal selection are among the most important varieties for table grapes and raisins grown in Stefanesti. They have been noted through a series of qualitative, production and adaptability traits to different environmental conditions.

Victoria variety (fig. 1) was obtained by complex sexual hybridization, by Victoria Lepădatu and Gh. Condei at ICHV Baneasa and continued studies at S.C.P.V.V. Drăgăşani.

Figure 1. *Victoria* variety

Morphological characteristics: The mature leaf is medium in size, wedge-shaped, with five lobes, with a light green color, unpigmented with anthocyanins. The shape of base of petiole sinus is V-shaped, open, the hairs between main veins on lower side of the blade - none or very low. The bunch are large, long, with medium compactness and the slightly lignified peduncle. The berries are large, with pleasant

appearance, elongated elliptical shape, and the color yellow-green. It is also characterized by: uniformity of size, thin bloom, thin skin that coats the strong consistency pulp.

Agro biological and technological characteristics: The variety is of medium vigor towards the high. Fertility coefficients (absolute and relative) have values between 1.5-1.80 (CFA) and 0,9-1,2 (CFR), and productivity indices (ipa and ipr) express the productive capacity of the variety (300-600). It ripens during the stages II–III, when it accumulates on average 139 g/l sugars and an acidity of 3-3,8 g/l H_2SO_4. The average crop per plant is 4,0kg, and the total output calculated per hectare is over 17,0 t, of which 90% of merchandise production.

The main phenophases: bud burst: 29.04-5.05; start of flowering: 3.06-8.06; beginning of berry ripening: 21-27.07; full physiological maturity of the berry: 10-28. 08. Good resistance to diseases, pests and behaves well to the hoar-frost and frosts of spring due to the later bud bursting. The variety is cultivated on large areas in the country and abroad.

The characteristics that showed interest: earliness, size of bunches, berries, berry shape and color, frost tolerance.

The *Canner* variety *(Hunisa x Sultanina)* was obtained in 1963 by P.H. Being an seedless variety, it is recommended for obtaining raisins, sweetness and juice.

Morphological characteristics: The mature leaf is very large, wedge-shaped, with five lobes, green colour. The anthocyanin pigmentation is low, goffering of blade is weak and the teeth are long, short relative to base width, both sides straight. The leaf is also characterized by: the shape of the petiole sinus is open compared to the upper lateral sinuses that are closed, prostrate hairs none. In relation to the middle vein the petiole is shorter. The shape of bunch is funnel shaped, large, loose. The berry is large in size and length, it has an broad ellipsoid shape, and the yellow-green color, rusted on the sunny side. Firmness of flesh is slightly firm, medium juicy and with small rudimentary seeds.

Agro biological and technological characteristics: The variety belongs to the group of varieties with very high growth vigor. Fertility coefficients (absolute and relative) have values between 1.40 and 0.9 and productivity indices - (absolute and relative) fall within the limits of 340 - 212.

Figure 2. *Canner variety*

The main phenophases: bud burst: 15-30.04, start of flowering: 5 -10. 06, beginning of berry ripening: 20 -30.07, full physiological maturity of the berry: 25.08 - 5.09. The average crop per plant is 2,5 – 4,0 kg/plant and 12 to/ha. It has medium tolerance to low temperatures in winter, to *Plasmopara* and *Oidium*. It ripens during the stages IV, accumulating a sugar content of 140-170 g/l and a acidity 4,4 – 6,4 g/l H_2SO_4. The average weight of a bunch reaches 300 g and the berry weight weighs 3 - 4 g.

The characteristics that showed interest: shape and color of berry, the size of bunches and berries, vigor, seedless.

RESULTS AND DISCUSSIONS

Within the populations of the two varieties subjected to clonal selection, several elites were selected. One elite of each variety it was particularly noticeable, for which they were multiplied and planted in the breeding greenhouse (fig. 3 şi 4).

Figure 3 and 4. Clonal selection of varieties: Canner şi Victoria

The main objective pursued by the clonal selection of the varieties presented was to obtain elites with grapes and large grain, which would exceed the plants of the selection plantation.

After a three-year study in the field of selection of elite plants, through which repeated measurements and weighing were performed on each selected individual, it was found that at least one elite was superior to the population in terms of average weight of bunches and berries.

The Victoria variety, valuable for its qualitative properties, especially for the weight of the bunches and grains, was surpassed by the selection **3-2-3.** Comparing the values expressed for the weight of the grapes, it can be seen in figure 5 that the variety subjected to the selection was exceeded by the elite by 53 g**.**

The 100 berries weighed on average per plant, for 3 years, show us that the selection presented larger and larger berries (821 g elite, compared to 808 population) demonstrating the improvement value of the *Victoria* variety (fig.5)
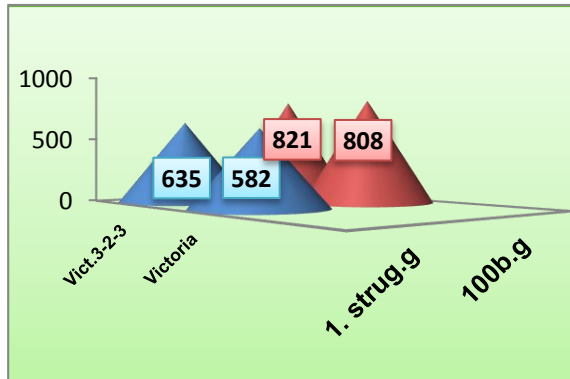
Figure 5. Average weight of bunches and 100 berries for *Victoria* variety and selection **3-2-3**

Wishing to obtain clonal selections with seedless berries, larger, crunchier and more appealing than the Canner variety, several different plants were chosen by these characteristics. Elita 35-2-1 proved superior to the population, the weight of 100 berries exceeded the variety by 25 g, while the weight of the bunches approximated the two genotypes (fig.6).
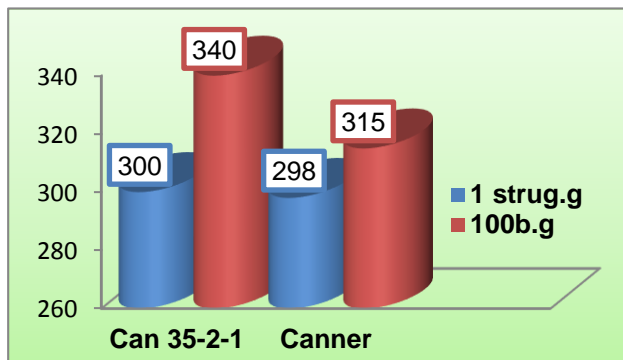

Figure 6. Average weight of bunches and 100 berries for *Canner* variety and selection **35-2-1**

CONCLUSIONS

Following the clonal selection, the *Victoria* **3-2-3** and *Canner* **35-2-1** selections were obtained, which outweighed the varieties selected by weight of bunches and berries. It can be stated at the same time that the two varieties transmit in the vegetative descendants valuable characteristics, resulted through the process of breeding plants.

The Victoria variety valuable for its qualitative properties, especially for the weight of the bunches and berries, was exceeded by the selection **3-2-3**, comparing the values expressed for the weight of the bunches, that the variety submitted to the selection was exceeded by the elite by 53g.

The 100 berries weighed on average per plant, for 3 years, show that the selection presented larger and larger berries (821 g elite, compared with 808 population) demonstrating the improvement value of the *Victoria* variety.

And in the case of the elite **35-2-1** this proved superior to the population, the weight of 100 berries exceeded the variety by 25 g, while the weight of the bunches approximated the two genotypes.

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