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THE DIVERSITY OF GENETIC RESOURCES IN THE ALBANIAN OLIVE

SUMMARY

This study for the diversity, were evaluated the genetic variation of 56 autochthonous olive genotypes *Olea europaea* L from Albania. Morphological marker based analysis were performed for olive identity characterization, to determine their localization, and usage limits. The description was done for each olive genotype, of 49 characteristics of tree, leaf; inflorescence, fruit and endocarp were measured during the study. Analysis of variance verified the morphological, technological and physiological distances and showed cultivar classification. Principal component analysis (PCA) was used to compare fruit, pit, leaf and growth habit characteristics between olive resources. Basing on the endocarp characteristics, as an important morphological marker, olive cultivars are clustered in seven groups. According to the oil content, genotypes are clustered in three main groups in low, medium and high oil content. Some of fruit and endocarp features (D, d, D/d, T/E, weight) were highly related to the oil content (R^2=0.871). In general, clustering of cultivars would suggest the existence of a strictly related genetic base with little morphological differences. The diversity is classified in two centre (i) South-West, with diversity and richness coefficient of 3.45 & 89 (ii) Central-West, with 1.41 & 65. Morphological analyses of 56 genotypes hold up the hypothesis for the autochthonous origin of olive resources and in this respect the hypothesis on the evolutionary history of the olive in Albania.

Keywords: Biodiversity, Variability, Genotype, Endocarp, Regions, *Olea europaea*.

INTRODUCTION

Albania is a typical Mediterranean country with rich genetic diversity. Different researchers have shown that the genetic resources of the olive have two distinct origins: one part of them derive from the cultivated form, whereas others derive from wild forms, Caballero JM et al. (1986). Researches for the cultivation of the autochthonous cultivars carried out in collaboration with IVALSA, Florence and INIA, Kordova, have proved Albanian typicality for 22 genotypes of the species *Olea europaea* Sativa, Belaj et al.

The “mist-propagation” researches for the rhizogenic capacity of the autochthonous varieties, proved responsibility of the genetic factors on this

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variability, Ismaili et al (2011). Study on the phenotypic changes as a result of the extreme extension of the species origin, has often made phenotypic deviations become a source of confusion in designations and synonyms, which people have wrongly pretended as new varieties, Damigella P. (1960). However, despite these attempts recognition of all the autochthonous resources and their characteristics still remains far away. This study aims to explore the super-centennial individuals of the *Olea europaea* L., to define their antiquity, to make the inventory, characterize and assess the genetic autochthonous wealth of the species *Olea europaea sativa* in Albania.

Figureure 1, 2, 3. Oil mill in Tirana and Vlora (IV century before JC).
The oldest olive in Albania (about 3000 years old).

MATERIAL AND METHODS

Analysis of Geographic diversity. During the period of 2008-2012, in situ inventory was carried out for the oldest genotypes of *Olea europaea* L. subsp. Sativa, Sylvestris (Mill.) and subsp. Oleaster Hoffmans, to prove autochthonism and antiquity. The super-centennial individuals were identified in each varietal population. The genotypes were collected and analyzed for their age, location, taxonomic values, presence of synonyms and degree of similarity. The degree of diversity and genetic wealth was analyzed based on climatic valences, biological indices and geographical elements. The prediction is realized on DIVA-GIS (Bioclim/Domain) Modeling method.

Analysis of morphological components. The genotypes were analyzed for 23 characters, according to Rezgen 96/9 COI, and Baldini, E. (1955). 100 fruit were analyzed randomly, 50 leaves, 50 crowns and 100 endocarps.

Analysis and comparisons were carried out within and among cultivars, with simple statistics univariate, F-test, Tukey-kramer for the distinctions between the genotypes and the characters.

The distances and relations among the main components were analyzed. The total variability and the possessive components of variability were identified through Principal Component Analysis and Cluster Hierarchical Ward method. Whereas the levels of relations between independent factors were identified through the multivariate correlation method, JMP.SAS/STAT (2008).

RESULTS AND DISCUSSION

In Albania the Mediterranean olive, which is widespread *Olea europaea L. subsp. europaea*, with two subspecies *europaea*, for the mild olive (domestic), and *sylvestris* (Mill.) Lehr, *oleaster* or wild olives. The presence of oleasters was proved 12.000 years B.C, Forbes H et al (1978). Whereas the cultivation of the olive *Olea europaea* L. sativa has been known since 5000 years before that, but major developments occurred 500 years B.C. It is reported that a lot of olive mills discovered in Aulona, Himara, Kanina, Tirana etc, are related contemporarily with some olive trees about 3000 years old, which belong to 300-500 years B.C., Ismaili H. et al(2010). (Figure 1, 2, 3). Based on the analysis of the circumference of the neck, in correlation with the dynamic index of the wood, Botari et al (1952) which has defined the age of the trees, it results that the oldest olive in Albania is the olive 'Brret'' (Figure-3). The above analysis estimates the olive 'Brret'' to be about 3000 years old. There are a lot of individuals which resemble to the olive ''Bret', according to the study specifically 4-5 other main varieties, such as the following: Black olive, The white Tirana, Kaninjot, Kryps Berati, Olive Himara, etc.

The names of the olives derive from their origin, morphology of fruit or destination. In 1912 Albania cultivated 8.1 million olive trees (state's archive), whereas in 2011 there are 12 million trees with 14 autochthonous cultivars, which comprise 80% of the overall surface of the olive groves (SOG).

Tablele 1. Genetic wealth of the olive in 2011

Subspecies	*Index of genetic resources in situ*	*Index of genetic resources ex situ*	*Collaborative organisms*
O.europaea L. sativa	104 varieties, Forms, Biotypes	*35 cv.*	*UBT, Seednet, Eurisco. SUT*
O. europaea oleaster	37. varieties,, Forms, Biotypes	*5 cv.*	
O.europaea sylvestris	13 varieties, Forms.		

Geographic Olive diversity. The olive presents a variety of shapes and constitutes a great genetic diversity. It is pretended to have 44 cultivars or populations. The main genotypes have geographical distribution in the form of hotbeds and typical regions which make up the origin. This regionalization is the cause of the relations between the climatic valences as well as the biological varietal constants. From this point of view Albania regionalizes the olive in two areas: (i) the Southern –Western area under the influence of the Ionian sea and (ii) the central area under the influence of the Adriatic sea, Koppen W. (1923), (Figure-4).

The Southern –Western area under the influence of the Ionian sea, is dominated by the population of Kaninjot cv. The central area under the influence of the Adriatic sea, is dominated by the population of olive white. Both hotbeds have different climatic and pluviometric isotherms. The coefficient of variability of active annual temperatures ∑ (t-t°) for both areas is 31%. The Southern – Western area collects 3014°C (t-t°), whereas the central and north area 2568°C.

The autochthonous diversity of the olive in Albania is represented by 154 genotypes, (Tablele-1). It consists of 104 genotypes *Olea europaea sativa*, 37 genotypes *Olea europaea oleaster*, 13 genotypes *Olea europaea sylvestris*. The index Brillouin of the Diversity calqued with the method DIVA-GIS for both above mentioned areas results 3.45 for the Southern –Western area and 1.41 for the central area, which proves the presence of a higher level of olive diversity in the Southern –Western area, compared to the central area (Figure-4). The prediction is realized on DIVA-GIS (Bioclim/Domain) Modeling method. The coefficient of variability is 41%. In Figureure-4, on the map there is distribution modeling of three species for the diversity and richness coefficient, *Olea europaea* sativa is coexisting with the other oleasters in both areas, whereas the wild olive (*sylvestris)* is found disproportionally, 91.3% in the Ionian area and only 8.7% in the Adriatic area. This is explained by the fact that the bioclimatic of sylvestris is found in the Southern-Western area with a hotter climate, Velitzelos E. et al (2005).

The coefficient of variation for the diversity of the three subsp in the Ionaian area is 1.17, whereas in the Adriatic area cv=6.31.

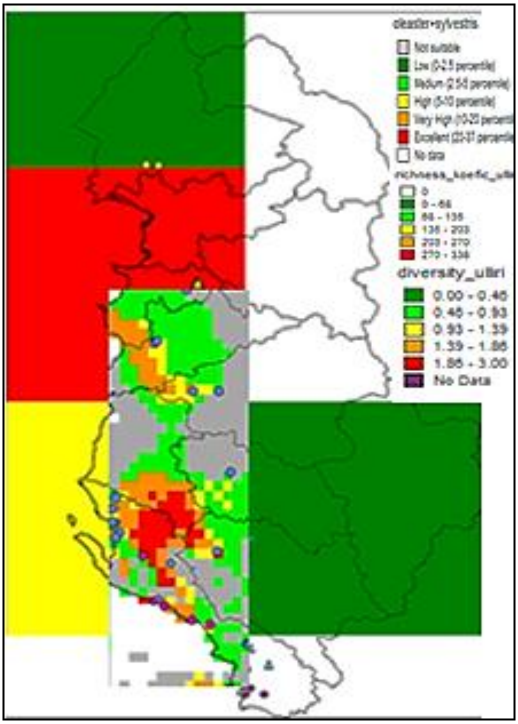

Figure 4. The distribution of three species for the diversity and richness coefficient realized on DIVA-GIS (Bioclim/Domain) Modeling method.

Analysis of the main components. The olive never dies because when it grows old it renews itself at the neck of the branches and the trunk, thus living without interruption. The idea that each olive has peculiar invariable identity and genetic features has been exploited for the description of the morphological characteristics as well as the characterization and classification of the olive germoplasm (Figure-5). The analysis of 56 genotypes proved that they derive from 3 taxonomic roots: sativa, oleaster, sylvestris. The genotypes have different characteristics of the fruit, endocarp and leaves. Their identification and classification was done in relation with the most sTablele characters to the environmental factors (endocarp and leaf), which made us identify the degree of genetic affinity among each other.

Tablele 2. Data on the Fruit and Endocarp of the 56 genotypes *Olea europaea* L. (sativa, oleaster and sylvestris).

GENOTYPES	100 Fruits (g)	100 Endocarps (g)	Polp 100 Fruits (g)	Ratio P/E	Fruit (mm)		Endocarp (mm)		Fruit D/d	Endocarp D/d	Oil (%)
					D	**d**	**D**	**d**			
Bahuta	270 kl	44 mncp	226	5.1	22.3	15.1	16.3	6.8	1.5	2.4	21
B-Brari	255 mn	38 cpqrs	217	5.7	19.1	13.0	13.5	6.2	1.5	2.1	27
B-Kruja	262 lm	35 rstuv	227	6.4	21.2	13.6	11.8	5.6	1.5	2.1	26
Bllanic	366 i	54 defg	312	5.8	25.3	16.1	18.1	8	1.6	2.2	24
BoÇ	431 e	58 cde	373	6.4	22.3	18.3	13.5	9.6	1.2	1.4	24
B-Shkod	231 qr	41lmncp	190	4.6	19.5	14.1	13.4	7.1	1.4	1.9	24
Cerje	472 c	55 def	417	7.6	26.3	17.8	17	8	1.5	2.1	26
Freng	228 qr	38 cpqrs	190	5.0	29.7	14.4	14.5	6.6	2.1	2.2	27
Ganjoll	362 i	42 klmncpq	320	7.6	22.3	15.6	13.9	7.1	1.4	1.9	22
Gjykats	389 g	47 hjkl	342	7.3	21.8	19.2	13.1	7.9	1.1	1.6	21
H-Himar	139 u	32 uvvx	107	3.3	18.3	11.3	14.5	6.3	1.6	2.3	16
Kaninjot	389 g	43 klmn	325	7.5	21.7	19.9	12.7	6.9	1.1	1.8	27
Kan-Cil	402 f	64 bc	338	5.3	22.4	15.4	15.3	9.2	1.4	1.7	25
Kallmet	366 hi	52 efgh	314	6.0	21.5	17.3	13.1	8.4	1.2	1.6	20
Kallmet kv	230 pq	45 jklmn	185	4.1	21.9	15.2	13.2	7.2	1.4	1.8	18
Karen	223 r	28 yz	195	6.9	18.4	13.1	12.6	6.2	1.4	2.0	26
Kotruvs	223 r	35 tuvvx	188	5.4	17.6	13.4	12.4	7.1	1.3	1.7	23
Kryp_Ber	581 **b**	69 b	512	8.2	27.6	21.7	14.8	7.8	1.3	1.9	18
Kryp_Elb	449 d	52 fghj	437	8.4	25.3	21.5	12.4	7.1	1.2	1.7	21
Kryp- Kru	397 fg	53 defgh	344	6.5	21.3	17.5	13.5	8.5	1.2	1.6	20
Kryp- Kuc	865 **a**	90 a	775	8.6	33.4	27.6	23.4	9.9	1.2	2.3	15
Kryp-Shk	374 h	48 ghjk	326	6.8	19.9	15.5	13.1	8.6	1.3	1.5	20
Kuleks	273 kl	36 stuvv	237	6.6	20.4	16.1	15.1	6.6	1.3	2.3	18
Kushan	223 r	30 vxyz	193	6.4	18.9	13.4	12.2	6.6	1.4	1.8	26
Managjel	363 hi	46 ijklm	317	6.9	20.9	16.6	12.4	7.0	1.3	1.8	20
Marks	307 j	51 fghj	256	5.0	20.1	14.2	14.7	7.4	1.4	2.0	21
Micka	138 v	22vyxz	116	5.3	15.3	11.7	10.9	5.6	1.3	1.9	26

Mixan	274 k	38 cpqrs	236	6.2	19.8	13.7	13.3	6.2	1.4	2.1	26
Nis-Patosi	357 i	59 cd	298	5.0	21.9	15.3	16.7	7.7	1.4	2.2	22
Perk	355 i	44 lmnc	311	7.0	21.9	16.7	12.6	7.1	1.3	1.8	20
Pulazeqin	192 s	34 stuvv	158	4.6	22.7	15.6	15.9	8.1	1.4	2.0	16
Qumushtor	429 e	42klmn c	387	8.5	22.2	16.3	13.7	5.1	1.4	2.7	18
U-Kuq	212 rs	35 rstuv	177	5.1	18.1	12.4	11.4	6.2	1.4	1.8	22
B-Tirana	245 mno	31 vxyz	214	6.9	21.5	14.6	13.9	6.4	1.5	2.2	28
UZ-Durr	237 op	37 pqrst	200	5.4	19.7	13.6	14.9	6.7	1.4	2.2	20
UZ-Ndroq	241 no	38 cpqrs	203	5.3	20.3	13.8	15.2	6.9	1.5	2.2	19
V-Peqini	284 j	43 klmn	241	5.6	23.2	16.0	13.7	6.5	1.45	2.1	26
G-44	222 r	38 cpqrs	184	4.8	18.5	11.1	13.8	6.6	1.7	2.1	16
Nis-Bregu	129 v	29 xyz*	100	3.4	19.2	13.9	12.7	7.9	1.4	1.6	15
O.K.GJ.T	136 v	37 pqrst	99	2.6	17.3	11.2	16.6	6.6	1.5	2.5	10
Ol.C.Elb	116 w	33 vxyz	83	2.5	20.3	12.5	16.0	6.1	1.6	2.6	9
Ol.K.Tir	97 x	21vyxz <	76	3.6	16.4	9.9	13.7	6.3	1.6	2.2	11
Ol.C.T	97 x	17 yt>	80	4.7	18.7	8.9	12.1	6.0	2.1	2.0	8
Ol.Z.Ber	62 y	12 >*-	50	4.1	13.8	7.6	11.6	5.0	1.8	2.3	9
Unafka	169 t	39 pqrst	130	3.3	16.3	12.7	11.2	7.6	1.3	1.5	13
Oliv-kruje	110 w	34 vvxy	76	2.2	14.7	11.3	11.3	6.8	1.3	1.7	8
O.K.GJ.E	113 w	27 yz*	86	3.2	17.7	11.6	16.7	6.5	1.5	2.6	8
Oliv.Z.E	106 wx	24 z^	82	3.4	16.3	10.9	12.1	5.9	1.5	2.0	8
Pul. Himare	160 u	28 yz	132	4.7	16.3	11.8	12.6	6.1	1.4	2.1	13
Oliv Vlore	112 w	34 vvxy	78	2.3	15.8	9.7	14.4	6.5	1.6	2.2	11
Oliv K.Brar	98 x	23 /^	75	3.2	16.4	10.1	12.2	5.6	1.6	2.2	6
Olivt Brar-1	75 y	19 -zy	56	2.9	12.9	9.9	10.3	5.5	1.3	1.9	7
Ullast Sasari	43 z	10 þě	33	3.3	10.1	7.7	8.0	6.2	1.3	1.3	5
Ull Kanine	37 *	11þğ	26	2.4	9.7	6.7	7.3	5.6	1.4	1.3	6
Gjonat	39 *	10 þě	29	2.9	11.1	10.2	8.5	5.7	1.1	1.5	8
Ulla Qeparo	36 *	12 þc	24	2.4	12.3	8.2	10.1	5.2	1.5	1.9	8

Levels not connected by same letter are significantly different.

Fruit and endocarps of the genotypes had different average weight from one another. The coefficient of variability resulted high, respectively 19.7% and 9%. Fruit weight varied from 0.6g up to 8.7 g (Table-2). Generally the weight of each genotype showed stability. Analysis of fruit variability within the genotype proved that 92.6% of them do not have statistical variations, i.e. it is the influence of the genetic factor, whereas 7.4% have obvious changes under the influence of other factors, especially of the environment.

In 87% of the genotypes, fruit weight influenced endocarp weight, R^2=0.845. Fruit form resulted with strong connection and influence with fruit weight R^2=0.770, and with average connection and influence with endocarp weight R^2=0.516, (Figure-6). Generally the values of the ratio between the two diameters (D/d) of the endocarps of each genotype are invariable. They were not influenced by the sizes, weight or by the environmental factors. In 77% of the genotypes there were strong connections between the ratios D/d of the fruit and (D/d) endocarp R^2=0.601, (Figure-6).

Because of being a product of metabolism, oil percentage in the fruit was characteristic and a distinguishing feature for each genotype. The values of oil percentage presented changes between the genotypes and had great variation cv=13.7%. The genotypes were rich in fats and 72% of them had more than 18% oil (fresh matter), (Table-2). Fruit and endocarp size, especially the ratio between pulp and endocarp, presented average up to great influence in the oil percentage (Figure-6).

The leaf is a distinguishing feature. From and symmetry are typical for each genotype. Surface and sizes (L,l) of the leaf genotypes are considerably different, and have fluctuated from 39-68 mm and 9-17 mm (Table-2). The wild olive *Olea europaea sylvestris* generally have small size leaves. Leaf colour has slight changes which is more intensive in the wild olives.

Table 3. Values of morphological characters of olive for the first three PC (56 genotypes).

Principal Components / Factor Analysis				
Number PC	**Eigenvalue**	**Percent**	**Percent**	**Cum Percent**
1	8.7683	54.802		54.802
2	2.2893	14.308		69.110
3	1.7228	10.768		79.878
	Eigenvectors			
Characters	X	Y	Z	
PF	0.49040	-0.07594	-0.11224	
PP	0.42577	-0.08268	-0.12185	
P/E	0.26023	-0.06383	-0.29992	
DF	0.22382	0.36655	-0.04760	
dF	0.31881	-0.09205	-0.10701	
DE	0.24282	0.34113	0.17208	
dE	0.25947	-0.15831	0.00167	
FD/d	-0.10170	0.47858	0.16669	
ED/d	0.03018	0.55308	0.19692	
V	0.19548	0.07636	0.44461	
bL	0.25200	-0.31760	0.21781	
LL	0.28501	0.39939	-0.14396	
lL	0.13957	-0.28951	0.53337	
LL/l	0.16984	0.39153	-0.19527	
LS	0.75647	-0.13212	-0.00080	
PE	0.12001	-0.01249	0.32118	

The complex characteristics of the tree, leaf, fruit, and endocarp were the main dominants of the morphological changes. PCA analysis identified 18 out of

23 main components which explain 97.8% of the total variability. The components with values (eigenvector) more than 0.3, possess 79.8% of the total variability in the 3 first PC. respectively PF, PP, dF, LS rank in PC1, because they possess 54.8% of the total variability. In PC2, there are 6 components which possess 14.3%, whereas PC3, 3 components possess 10.7% of the variability, (Table-3).

Analysis with 18 components with cluster average has paired fragments, leader and joiner within groups of resemblance at different distances, and frequencies presented in table (Figure-5).

The distant level was from 0.7 up to 16.7. In (G1) 36 genotypes were positioned in two subgroups. 26 genotypes *Olea europaea* sativa with small up to average fruit, oval and cylindrical form, average weight and high oil beam, result to be related to the oleasters resembling to form, symmetry, size, ratios, but are really distant for the oil percentage and some leaf characters (Figure-5).

Frequencies between the main morphological dominants are strongly up to weakly related, but they are always variable among genotypes.

In G2, which includes 5 genotypes, they have significant morphological distance. It includes *Olea europaea sylvestris*, all genotypes with a frequency of values from 0.7 up to 1.01, and with considerably small and similar fruit. In G3, the classification includes genotypes of average up to great fruit, slightly spherical or oval; it includes 14 genotypes. On the other hand these genotypes are related to Kryps Kuci cv, whose fruit resemble in symmetry and form, the ratios D/d of fruit and endocarp, but vary considering the average weight of the fruit and endocarp and the percentage of oil in the fruit (Figure-5).

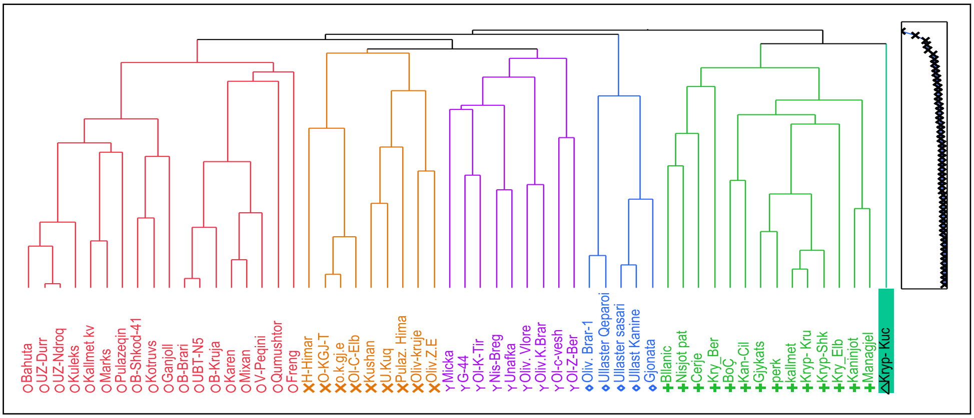

Figure. 5. Dendrogram Hierarchical clustering for analysis of the similarity of the genotypes based on distance computed from pairwise comparisons of quantitative characters between 56 individuals of sativa, oleaster and sylvestris cultivar.

Generally 56 genotypes were positioned in three important groups, at a level of resemblance 34.5%. The genotypes in G1 have variability in relation to G2 71.4%, whereas with G3 83.5%. The genotypes within G1 have resemblance

63.6%. The genotypes in G2 78.2%, and in G3 85.4%. The cultivar Kryps Kuci is far more distant compared to the group of "Kryps" components and has a coefficient of resemblance 73,3%.

The analysis of the autochthonous genotypes with PCA proved 3 cases of perfect synonymy, with strong relation (i) within the population of the black olive, 5 genotypes which have resemblance 93.7%, UZ-Durr, Kallmet-kv, Kuleks, UZ.Ndroq, Bahuta (ii) in the population on olive white, three genotypes with resemblance (89.3%), are: B-Tirana, B-Kruja, Karen, B-Brari, B-Shkod and (iii) in the population of the Kryps there were 5 small groupings with variability. Considering the phenotypic viewpoint these genotypes have on average resemblance within the relations.

In 12 names of the oleasters 3 groups resulted with high resemblance or as synonyms. In *Olea europaea* sativa (domestic), 3 groups resulted with high resemblance or as synonyms. Whereas in the group of the Oleaster genotype, there were three synonym genotypes, O.K.Gj.E, with O.C.E and O.K.Gj.T.

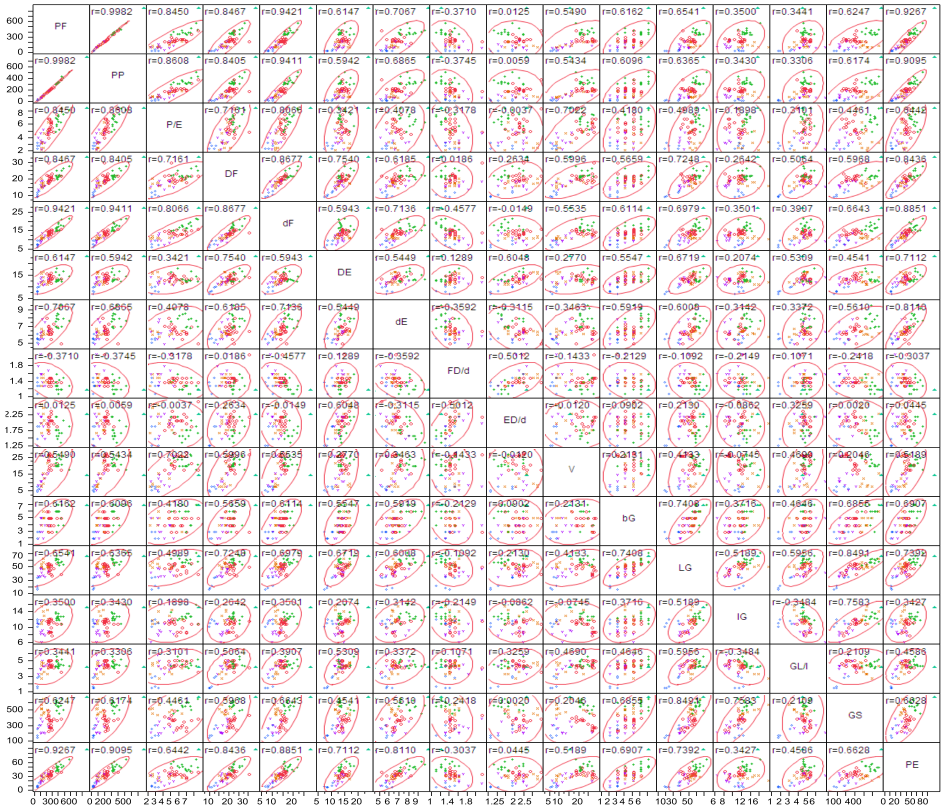

Figure 6. Dendrogram generated by Scatterplot Matrix Multivariate Correlations analysis based on distance computed from pairwise comparisons of quantitative characters between 56 genotypes of Albanian cultivar.

The genotypes being studied have o low coefficient of resemblance 34.5% among them, thus proving the hypothesis for the existence of high diversity in the analysed genotypes.

CONCLUSIONS

Being under the Mediterranean influence Albania has a lot of resources, a high coefficient of wealth and diversity of the Olea species. Considering these conditions the forms sylvestris and oleaster are cultivated naturally.

Results have shown the existence of a considerable variability among the population of the wild olives in relation with its two other subdivisions olea sativa and oleaster. But there are no clear cut boundaries between olea sativa and oleastres.

Analysis of the phenotypic components has arranged the varietal confusion. This means that 56 of the genotypes analysed for their morphology, derive from three basic subspecies Olea sativa, oleaster and sylvestris.

Morphological marker based analysis were performed for olive identity characterization, to determine their localization, and usage limits. Analysis of variance verified the morphological, technological and physiological distances and showed cultivar classification. Principal component analysis (PCA) was used to compare fruit, pit, leaf and growth habit characteristics between olive resources. In general, clustering of cultivars would suggest the existence of a strictly related genetic base with little morphological differences. The diversity is classified in two centre (i) South-West, with diversity and richness coefficient of 3.45 & 89 (ii) Central-West, with 1.41 & 65. Morphological analyses of 56 genotypes hold up the hypothesis for the autochthonous origin of olive resources and in this respect the hypothesis on the evolutionary history of the olive in Albania.

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DIVERZITET GENETIČKIH RESURSA MASLINE U ALBANIJI

SAŽETAK

Ovom studijom o diverzitetu ispitane su genetičke varijacije 56 autohtonih genotipova masline *Olea europaea* L iz Albanije. Analizom na bazi morfološkog markera izvršena je karakterizacija identiteta masline, određene su njihove lokacije i ograničenja u upotrebi. Urađen je opis svih genotipova, a tokom istraživanja mjerene su karakteristike 49 sTableala, lista, cvasti, plodova i endokarpa. Analiza varijanse je potvdila morfološke, fiziološke i tehnološke razlike i izvršila klasifikaciju sorte. Analiza glavnih komponenata (PCA) je korišćena za poređenje ploda, koštice, lista i karakteristike rasta između maslina. Na osnovu karakteristika endokarpa, kao važnog morfološkog markera, sorte masline su grupisane u sedam grupa. Prema sadržaju ulja, genotipovi su podijeljeni u tri osnovne grupe sa niskim, srednjim i visokim sadržajem ulja. Neke osobine ploda i endokarpa (D, d, D/D, T/E, težina) su bile veoma povezane sa sadržajem ulja ($R^2 = 0,871$). U principu, grupisanje sorti ukazuje na postojanje strogo definisane genetičke osnove sa malim morfološkim razlikama. Diverzitet je podijeljen u dva centra (i) jugozapadni, sa koeficijentom diverziteta od 3,45 & 89 (ii) centralno-zapadni, sa koeficijentom 1,41 & 65. Morfološka analiza 56 genotipova potvrdila je hipotezu o autohtonom porijeklu resursa masline i u vezi sa tim, hipotezu o istoriji evolucije maslina u Albaniji.

Ključne riječi: biodiverzitet, varijabilnost, genotip, endokarp, regije, *Olea europaea*.