Screening the Rooting Ability by Leafy Cuttings of Some Olive Varieties (*Oleaeuropaea*L.)

Yamen Mahfoud [*1]FaisalDoai[**2], WafaaChoumane[***3]

[*]*Postdoc scholar, chair of Plant physiology, Institute for Botany, Technical University Dresden, Germany.*

*** Professor, Department of Horticulture, Faculty of Agriculture, Tishreen University, Lattakia, Syria.*

****Professor, Department of Basic Sciences, Faculty of Agriculture, Tishreen University, Lattakia,Syria.*

Abstract:

This research was carried out during the years 2016 and 2017 on 23 varieties of olives (Oleaeuropaea L.) planted in the orchard in Bouka Center for Research and Plant Production, Lattakia, Syria. In order to investigate their rooting ability by leafy cuttings treated with Indole butyric acid under glasshouse conditions. Varieties were classified according to their rooting ability depending on the International Olive Council method.

Varieties included 10 introduced (Chemlal, Chemlaly, Tanche, Picholine, Frantoio, Coratina, Gordal, Zorzalino, Trilia, and Conservolia) and 13 local ones (Khdairi, Hmaisi, Mhati, Dermlali, Sorani, Doaibli, Klkali, Mnaikiri, Abo-Satl, Dan, Qaisi, Jlot, Mosaabi), with three trees of each variety, which were already evaluated in terms of productive aspects and characterized morphologically and genetically.

The rooting possibility ranged between varieties. Some local varieties (Khdairi, Dermlali, Sorani, Doaible, Mnaikiri, Abo satl, and Dan) were characterized by medium rooting ability, whereas all of the introduced varieties had the medium rooting ability, except for Gordal, Tanche, and Conservolia that showed difficult rooting ability.

Rooting percentage ranged between (0.62%) in Mosaabi variety as an average of two seasons and (58.75%) in Zorzalino variety which achieved the best results in both seasons.

Keywords: *Olive, varieties, leafy cuttings, IBA, rooting media, perlite, glasshouse.*

I. INTRODUCTION&LITERATURE REVIEWS

Olives (*Oleaeuropaea* L.) is a long-lived evergreen tree, native to the eastern coast of the Mediterranean basin, where more than 90% of olive resources are located. Its habitat is determined by the Mediterranean climate, which is characterized by relatively mild winters and hot, dry summers. The area is belonging to this climate type lie between 30º and 45º north and south latitudes. Olives are grown under various climatic (altitude, temperature, rainfall) and soil conditions, which had contributed to the conservation of genetic variation of olives (Vossen, 2007; Zohary& Spiegel-Roy, 1975). Syria has been known as one of the most popular countries in terms of production and export of olive oil for more than 3000 years, and the olive tree still has a wide as a wild tree in the North-west Mountains of Syria (Zohary, 1994; Janick, 2005).

Olive cultivation is mainly concentrated in the Mediterranean basin countries, and according to FAO statistics, the world's cultivated area of olive trees reached (10,513,320 hectares) in (2018) with total production exceeded 21 million tons, only about 10 % of them is used for table olives, while the major remaining percentage is channeled into oil production. Spain is the leading country in the ranking for olive production, followed by Italy. Syria holds the sixth place in world olive production with more than one million tons of olive fruits in 2012, which formed about 5% of world olive production. (FAO, 2018; AOAD, 2015)

Different types of hormonal solutions are used in rooting the cuttings, mainly indole butyric acid (IBA), indole acetic acid (IAA), naphthalene acetic acid (NAA), or mixtures of two types of these acids.(Isfendiyaroglu and Ozeker, 2009)

However, indole butyric acid is considered the best in terms of the success rate of rooting, because of its high stability against the degradation enzymes produced by the cuttings used for propagation (Epstein &Lüdwig-Muller, 1993), (Nordström*et al.*, 1991). Recently, high concentrated hormonal solutions for a short dipping period (a few seconds) have been used instead of diluted solutions for a long period that may extend from minutes to hours.

For the optimal concentration of the hormonal solution, (Doai& Sheik Yusef, 1982) found that 6000 ppm of IBA achieved the best results on Syrian variety Sorani. (Rahman *et al.*, 2002) found that the concentration of 3000 ppm gave rooting percentages higher than 70%, and the 2000 ppm concentration was the best for rooting the leafy cuttings of the Cassanese variety according to a study of (Briccoli, 1989). While many studies have reported that the optimal concentration of indole butyric acid is 4000 parts per million in most varieties of olives, and this concentration is the most widely applied in the nurseries of olive propagation of leafy cuttings

worldwide (Khajehpour*et al*., 2014) (Lazaj*et al*., 2015) (Shahab *et al*., 2017).

As for the media used for rooting, perlite, and vermiculite are the most commonly used or mixtures of these two media in specific proportions. Rooting of the leafy cuttings of the Ayvalikvariety reached 95% in a mixture of perlite and vermiculite medium at a ratio (1: 1), which according to the study (Isfendiyaroglu&Ozeker, 2009) was the most suitable medium for rooting the leafy cuttings of olives in economic terms, while the rooting percentage did not exceed 5% when using pure sand as a rooting media.

(Doai& Sheik Yusef, 1982) results indicated that using a medium of crushed black basaltic stones available in the "Shahba" area in the governorate of "Sweidaa" with sawdust achieved acceptable results on the local varieties Khdairi and Dermlali compared to imported perlite and vermiculite media, and it reduced production costs.

Rooting success with leafy cuttings depends on the variety, the age of the wood used, the location of the cuttings on the branch, and the period in which the cuttings are taken (Fabbri*et al*., 2004; Hartmann *et al*., 2001).

Varieties range widely in their ability to rooting; it was about 20-30% for Sevillanovarieties while reached 95-98% for Manzanillo and Nivadillovarieties, while it did not exceed 10% for the variety Kalamata in the best conditions (Sutter, 2005).

(Hechmi*et al*., 2013) recorded that the percentage of rooting was 10% for Picualvariety, while it reached 85.1% for Arbequina variety and 78% for Curoniki in Perlite medium with 4000 ppm of Indole butyric acid.

In the study of (Kaim&Bisht, 2017), the rooting percentage of Frantoio variety reached 45%, while it did not exceed 25% for the variety Pendulino in a medium of perlite. A study (Denaxa*et al*., 2010) showed that the rate of rooting of leafy cuttings for the variety Arbequina reached 96% and for the Mastoids to 60%, while it did not exceed 2-5% for the variety Kalamata.

Publications of the International Olive Council (Barranco *et al*. 2000) stated that the leafy cuttings of some varieties such as Frantoio, Coratina, Zorzalino, and Trelia are characterized by a high ability for rooting, while it was moderate in other varieties such as Conservolia, Picholine, and Doaibli, and weak in the varieties Shemlal, Shamlali and Al-Qaisi, and too weak for the Spanish variety "Gordal."

Depending on the age of the wood, the cuttings are divided into hard woody cuttings, half-woody, and Herbal or leafy cuttings, which is the most widely used on the commercial production in spites of a large number of seedlings, can be obtained from a single tree compared to the traditional propagation of cuttings. (Fabbri*et al*., 2004)

As for the position of the cutting on the branches, most studies indicate that the basal cuttings are more capable of rooting than the middle and upper ones due to their enrichment in nutrients that contribute to the success of the rooting process (Avidan&Lavee, 1978), with few exceptions in some varieties as is the case in the Darmlaly variety, since rooting success rates were better for the cuttings were taken from the upper part of the branch than the basal and medial ones (Doai&Fadliah, 2009)

In terms of when the cuttings were taken, experiments have shown that it is directly related to cambium activity, which is greatest in spring and autumn in Mediterranean basin conditions where temperatures tend to be moderate. Its activity slows with high temperatures in the summer and low in the winter (Doai and Ismael, 1996; Doai and Fadliah, 2009; Avidan and Lavee, 1978; Wiesman and Lavee, 1995).

II. STUDY IMPORTANCE & OBJECTIVES

Syria is characterized by the diversity of its environment, in terms of altitude, rainfall, temperature, and soil conditions. In addition, there are still many geographical areas that can be invested and planted with olives, because the olive tree is distinguished by its hardiness and its high ability to withstand various environmental stresses, and thus its ability to growth and production in Conditions that other fruit trees may not be able to withstand.

The issue of obtaining the necessary seedlings is the first obstacle that limits the horizontal expansion of olive cultivation. Moreover, to compensate for the large shortage of trees that occurred because of the ongoing war in the country and because of the fires and the unfair woodcutting. As the traditional methods of propagating, such asaromas, stem, etc., are unable to meet the need of the plants necessary for cultivation.

Hence, **this study aimed to** investigate the possibility of rooting the leafy cuttings of olive varieties in Bouka olive complex within the conditions of Lattakia Governorate. Furthermore, the propagation of varieties that were identified by good productivity indicators, to include them in the olive breeding and genetic improvement programs.

III. MATERIALS & METHODS

A. Date and place of study:

The study was carried out in the nursery and greenhouse in Bouka, Lattakia, which belongs to the

Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), during two years 2016 and 2017.

B. *Plant material:*

Samples were collected from 35 years-old trees for 13 local varieties and 10 imported ones, well known in the Mediterranean basin (table 1), Planted in the olive complex in Bouka Center for Research and Plant Production at Tishreen University, Lattakia, Syria after they were characterized morphologically and molecularly and evaluated in terms of productive and agricultural aspects.

The orchard is characterized by a heavy mud soil with alkaline reaction, high content of total and effective calcium carbonate, and good content of organic matter without any supplementary irrigation.

The area rises 36 meters above sea level. The average rainfall is 672 mm in 2016 and 702 mm in 2017, and the average daily temperature is 20.5ºC for 2016 and 20.86ºC for 2017 (according to Bouka meteorological station).

C. *Preparing the cuttings for planting:*

The cuttings were cut to a length of 12-15 cm, as studies indicate that it is the optimal length (Doai and Sheikh Yusef, 1982), in a straight and directly below the node from the bottom, and inclined from the top, with scissors sterilized with ethanol 95%, and two pairs of leaves were left on the top of the cuttings. The bottoms of the cuttings (3 cm apart) were dipped in a 4000ppm IBA hormonal solution for five seconds.

To ensure that the hormone reaches a distance of two nodes at least on the bases of the cuttings, after that, they were left horizontally for 5 minutes in the shade so that the ethanol was used in the preparation of the hormonal solution volatilized from the bases of the cuttings.

The planting was carried out at two periods during the year in terms of cambium activity, the autumn (25 September 2016), and the spring (15 April 2017), as the temperatures are moderate during these times of the year and suitable the success of the rooting process.

This greenhouse is devoted to propagating olives with leafy cuttings, which provides the appropriate conditions for rooting the cuttings such as proper temperature during the day and night, in addition, high humidity through a fog irrigation system that works Automatically, moreover, ventilation system, light and suitable medium for rooting.

Cuttings were planted in lines within the greenhouse basins in a medium of sterilized perlite.

D. *Estimating the rooting ability:*

Cuttings were pulled from the rooting medium 75 days after greenhouse planting (Fig. 5), dead and rooted cuttings were counted, and the percentage of rooting (R.A. %) was calculated (cuttings on which the callus formed but did not show beginnings of the roots were also considered dead).

TABLE I

Names, origins, and purposes of cultivation of the 23 studied varieties.

Variety	Origin	Purpose	Variety	Origin	Purpose
Khdairi	Syria	Dual*	Chemlal de Kabali	Algeria	Oil
Hmaisi	Syria	Dual	Chemlaly	Tunisia	Oil
Mhati	Syria	Dual	Frantoio	Italy	Oil
Dermlali	Syria	Dual	Coratina	Italy	Dual
Sorani	Syria	Dual	Gordal	Spain	Table
Doaibli	Syria	Dual	Zorzalina	Spain	Dual
Klkali	Syria	Dual	Conservolia	Greece	Dual
Mnaikiri	Syria	Dual	Picholine	France	Dual
Abo-satl	Syria	Dual	Tanche	France	Dual
Dan	Syria	Dual	Trilia	Turkey	Dual
Kaisy	Syria	Table	(Barranco *et al.*,2000) (Jibarae*t al.*, 2010)		
Jlot	Syria	Dual			
Mosaabi	Syria	Table			

*****Dual means variety used for table and oil extraction.

Rooted cuttings were transplanted into polyethylene bags, and cuttings on which the callus formed were replanted in the greenhouse again.

Varieties were classified according to the standards of the International Olive Council (Barranco *et al.*, 2000) to 4 main groups:

- **Unable to rooting:** no rooted cuttings
- **Low or weak rooting ability:** percentage of rooted cuttings is less than 20%
- **Moderately rooting ability:** the percentage of rooted cuttings is between 20 and 60%
- **High rooting ability:** the proportion of rooted cuttings is more than 60%

E. Statistical analysis:

The experiment was conducted using a completely randomized blocks design, with two blocks, 40 cutting of each variety per block.

Data were analyzed by ANOVA. Duncan's Multiple Range Test was then used to identify differences between the treatments (significance was set at $P<0.05$).

IV. RESULTS & DISCUSSION

Ease of propagation is one of the most important criteria that must be considered when deciding to adopt an appropriate variety for cultivation in a particular area.

Many studies indicate that some varieties that have good economic features such as the Spanish Gordal variety and the Greek Conservolia did not take their natural right to spread due to the difficulty of propagating them by modern methods on the one hand, and the insufficiency of traditional methods in securing the necessary seedlings to expand the cultivation of these varieties on the other hand.

According to the data of Table (2), the rooting percentages varied clearly between the studied olive varieties, whether local or introduced. Cuttings of the local varieties (Khdairi, Dermalali, Sorani, Daibili, Mnigiri, MuhazamAbustal, Dan) were of medium susceptibility to rooting, while they were weak among the rest of the local varieties.

As for the introduced varieties, most of them had a moderate rooting ability, except for the Spanish Gordal, Greek Conservolia, and French Tanchevarieties, which showed difficulty in rooting.

The Spanish varietyZorzalina achieved the highest percentage of rooted cuttings in the spring and autumn periods, reaching 68.75% at the autumn date in 2016 and 48.75% at the spring date 2017, while the percentage of rooted cuttings in the local Mossabi and Spanish Gordal varieties did not exceed 1.25% at the autumn season 2016, and rooting was completely missing from the local variety Musaabi at the spring season of 2017.

Our results are consistent with the results of Barranco *et al*., 2000) that the varieties Zororzalino, Frontoio, Trelia, and Coratina are easy to propagate by leafy cuttings compared to other varieties, while we differ with their results on the two varieties Shamlal Algerian and Greek Conservolia, as indicated by the results of (Barranco *et al*., 2000).

As they indicate that the Shemlal variety is difficult to root with leafy cuttings, and Conservolia is characterized by a moderate susceptibility to rooting.

It seems clear that the rooting rate at the 2016 fall date was higher than the rooting rate at the 2017 spring date, in contrast to many studies indicating that the spring date is the most appropriate for the success of the rooting process (Doai and Ismail, 1996) (Fabbri*et al*., 2004) (Denaxa*et al*., 2012), and this is related to climatic conditions, especially temperatures that directly affect cambium activity. This difference in rooting rates can be explained by the sudden increase in temperatures immediately after planting the cuttings that led to the low success rates of rooting at the spring date 2017.

TABLE 2
The percentage of rooting the leafy cuttings of the 23 studied varieties

Variety		Rooting percentage %			Rooting ability
		September2016	April 2017	average	
Local Varieties	**Khdairi**	53.75 abcd	35abcd	44.37 bc	moderate
	Hmaisi	20 ghij	10defgh	15 ghijk	weak
	Mhati	18.75 hijk	13.75cdefgh	16.25 ghij	weak
	Dermlali	43.75 bcde	35abcd	39.37 bcd	moderate
	Sorani	46.25 bcd	23.75abcdefgh	35 bcde	moderate
	Doaibli	37.5 defg	20bcdefgh	28.75 defg	moderate
	Klkali	26.25 efghi	12.5cdefgh	19.37 fghi	weak
	Mnaikiri	25 fghi	18.75bcdefgh	21.87 efghi	moderate
	Abo-Satl	36.25 defgh	22.5bcdefgh	29.37 defg	moderate
	Dan	58.75 abc	27.5abcdefg	43.12 bcd	moderate
	Qaisi	8.75 ijk	6.25efgh	7.5 ijk	weak
	Jlot	8.75 ijk	7.5efgh	8.12 hijk	weak
	Mosaabi	1.25 k	0 h	0.62 k	weak
Introduced Varieties	**Chemlal**	41.25 cdef	31.25abcde	36.25 bcde	moderate
	Chemlaly	26.25 efghi	18.75bcdefgh	22.5 efgh	moderate
	Frantoio	48.75 bcd	42.5 ab	45.62 abc	moderate
	Coratina	40 def	26.25abcdefg	33.12 cdef	moderate
	Gordal	1.25 k	3.75 gh	2.50 jk	weak
	Zorzalino	68.75 a	48.75 a	58.75 a	moderate
	Conservolia	3.75 jk	5fgh	4.37 jk	weak
	Picholine	61.25 ab	37.5abc	49.37 ab	moderate
	Tanche	13.75 ijk	11.25defgh	12.5 hijki	weak
	Trilia	47.5 bcd	30abcdef	38.75 bcd	moderate
average		32.1	21.2	26.63	

*Varieties with different letters are significantly different

V. CONCLUSION

From all above, we conclude the following:

- Some of the local varieties (Khdairi, Dermlali, Sorani, Doaibli, Mnaikiri, Abu-Satl, Dan) were characterized by a moderate ability to root their leafy cuttings, while it was weak among the rest of the local varieties.
- The Spanish variety Zorzalino achieved the highest percentage of rooted cuttings in the spring and autumn seasons, reaching 68.75% in autumn 2016 and 48.75% in spring 2017. While the percentage of rooted cuttings in both varieties, the local Mosaabi and the Spanish Gordal, did not exceed 1.25% in autumn 2016, and rooting was completely absent with the local variety is Mosaabi in Spring 2017.
- We recommend following up on the seedlings that we obtained and evaluate them of various aspects, especially of the varieties that were characterized by important productive indicators.

VI. REFERENCES

[1] P. VOSSEN. "Olive Oil: History, Production, and Characteristics of the World's Classic Oils." Hortscience. 42(5): 1093-1100. 2007.

[2] D. ZOHARY, P. SPIEGEL-ROY. "*Beginnings of fruit growing in the old world*." Science. 187: 327-329. 1975.

[3] D. ZOHARY. "The wild genetic resources of the cultivated olive." Acta Hort. 356: 62-65. 1994.

[4] J. JANICK. "*The Origins of Fruits, Fruit Growing, and Fruit Breeding*." Plant breeding rev. 25: 255-320. 2005.

[5] FAO. Food and Agriculture Organization of the United Nations. "*FAO Statistics Division*." 2018.

[6] AOAD. "*Arab Agriculture Statistics*." Yearbook - plant production. 35: 30p. 2015.

[7] Shaza Mahmoud Sabbouh, Smaan Alattuan, Ibrahim Mohammad Abdullah, "The Technical and Economic Efficiency of Olive Oil Production in the Syrian Coast" SSRG International Journal of Agriculture & Environmental Science 6.1 (2019): 62-66.

[8] M.ISFENDIYAROGLU, E.ÖZEKER, and S. BASER, "*Rooting of 'Ayvalik' Olive Cuttings in Different Media*. Spanish Journal of Agricultural Research". 7(1): 165-172. ISSN 1695-971-X. 2009.

[9] E.EPSTEIN, and J.LUDWIG-MÜLLER, "*Indole-3-Butyric Acidin Plants: Occurrence, Biosynthesis, Metabolism, andTransport*", PhysiologiaPlantarum: 88, 382-389. 1993.

[10] A. C.NORDSTROM,F. A. JACOBS, and L. ELIASSON, "*Effect ofExogenous Indole-3-Acetic Acid and Indole-3-Butyric AcidOn Internal Levels of the Respective Auxinsand TheirConjugation with Aspartic Acid*", Plant Physiology, 96(3):856-61. 1991.

[11] F.DOAI, and A. SHEIK-YUSEF, "*An experimental study of greenhouse olives propagation using the leafy cuttings*," Tishreen University Journal of Scientific Studies and Research - Series of Agricultural Sciences, Vol (1): 6, 13-29. 1982.

[12] N.RAHMAN,A. A. AWAN, G.NABI, and Z. ALI, "*Root Initiation in Cuttings of Olive Cultivar Coratina Using Different Concentration of IBA*," Asian Journal of plant sciences. 5: (1),563-564. 2002

[13] B. C.BRICCOLI, "*Rooting Trail with the CultivarCassanese*," Int. Symp. Olive Growing Cordoba: 26-29. 1989

[14] G.KHAJEHPOUR, V.JAM.EIZADEH, and N. KHAJEHPOUR, "*Effect of Different Concentrations of Indole butyric Acid Hormone and Cutting Season on The Rooting of The Cuttings of Olive (OleaeuropaeaVarmanzanilla*)" Int. J. Adv. Biol. Biom. Res: 2 (12): 2920-2924. 2014.

[15] A.LAZAJ, P.RAMA, and H. VRAPI, "*The Interaction with Season Collection of Cuttings, Indol Butyric Acid (IBA) and Juvenility Factors on Root Induction In Oleaeuropaea L. (Cultivar 'Kalinjot')*" Intl. Refereed J. Eng. Sci: 4(3), 32–38. 2015.

[16] J.SHAHAB,I. MUHAMMAD, K. S.IMRAN, A.NAWAB, M.MUHAMMAD, M. M.ANJUM,N. ALI, and M. N. SHUAEB, "*Response of Rooting of Various Olive Cultivars to IBA(IndolButyric Acid)*"Agri Res & Tech: 9(2):1-5. 2017.

[17] A.FABBRI,G. BARTOLINI, M.LAMBARDI, and S. KAILIS, "*Olive Propagation Manual"* Land links Press, Australia. 150p. 2004

[18] H. T.HARTMANN, D. E. KESTER and F.T. DAVIES *"Plant propagation: principles and Practices, 5th Edition*" Prentice-Hall, New Jersey.The USA. 2001.

[19] E. G. SUTTER, "*Olive Cultivars and Propagation*: In*Olive production manual*" (Sibbett G.T. and Ferguson**,**. eds.). 2nd ed., Univ California, Agriculture and NaturalResources, Publ: 3353 , 19-25**.** 2005.

[20] M.HECHMI, M.KHALED,S. ABED, A.EL-HASSEN,R. FAIEZ, and A. MOHAMED, "*Performance of Olive Cuttings (Oleaeuropaea L.) of Different Cultivars Growing in The Agro-Climatic Conditions of Al-Jouf (Saudi Arabia)*" American Journal of Plant Physiology: 8(1),41-49. 2013

[21] J.C.KAIM and V.K. BISHT, "*Rooting of Olive Cuttings (Oleaeuropaea L.) Cv. Pendolino and Frontoio in Relation To the Propagation Medium*" Adv. Pharm. J: 2(2): 69-73. 2017.

[22] N. K.DENAXA, S. N.VEMMOS, P. A.ROUSSOS, and G. KOSTELENOS, "*The Effect of IBA, NAA and Carbohydrates On Rooting Capacity of Leafy Cuttings In Three Olive Cultivars (Oleaeuropaea*L.*)*" In XXVIII International Horticultural Congress on Science and Horticulture for People (IHC2010): Olive Trends Symposium 924: 101-109. 2010.

[23] D.BARRANCO,A. CIMATO, P.FIORINO,L. RALLO, A.TOUZANI,C.CASTANEDA, F. SERAFIN and I. TRUJILLO, "*World Catalogue of Olive Varieties*" Internacional Olive Council, Madrid, Spain:360p. 2000.

[24] F. DOAI, and Z. FADLIAH "*Evergreen Fruit trees*" Directorate of University Books and Publications, Tishreen University, 500 pages**.** 2009

[25] F.DOAI and H. ISMAEL, "*The effect of some hormonal and mechanical treatments on the ratios of rooting the leafy cuttings of two olive varieties Khdairi and Dermlali*," Tishreen University Journal of Scientific Studies and Research - Series of Agricultural Sciences, Vol (4): 18, 37-23. 1996.

[26] B. AVIDAN, and S. LAVEE, "P*hysiological Aspects of the Rooting Ability of Olive Cultivars*" ActaHort, 79:93-101. 1978.

[27] Z. WIESMAN, and S. LAVEE, "*Relationship of Carbohydrate Sources and Indole-3-Butyric Acid in Olive Cuttings*" Aust. J. Plant Physiol .22:811-816. 1995

[28] G.JIBARA,S. ASHTAR, A.JAWHAR, M.KHATIB, Z.BIDO,R. ABDUL-HAMID, G.KOTMI, A.NSEIR,N.WAZAZ,S. MAKOUL, T. A.KALHOU,W.SABETTA, A.BLANCO, A.DRAGOTTA,A.IBRAHEM,E. DUBLA, F.CONTENTO,N.PERRUCCI, G.MAIELLARO, G. CARDONE,C. MONTEMURRO and F.FAMIANI, "*Oil Quality and Morphological, Phenological, Bio-Agronomical and Molecular Characterization of Syrian OleaEuropaea*L. *Germplasm***,**" In : Di**-**Terlizzi B. (ed.), Dragotta A. (ed.), Jamal M. (ed.). *Syrian national strategic plan for olive oil quality: final report.* Bari: CIHEAM, p. 85-94. 2007.