BOOK OF THE IOC NETWORK OF GERMPLASM BANKS

INTERNATIONAL SEMINAR | 21 - 24 OCT CÓRDOBA 2019

THE IOC NETWORK OF GERMPLASM BANKS AND THE TRUE HEALTHY OLIVE CULTIVARS PROJECT

UNIVERSIDAD DE CÓRDOBA

THE BOOK OF GERMPLASM BANKS

Cordoba (Spain), 21-24 October 2019

Introducing the Seminar

Luis Rallo. Convener and moderator

The cataloguing of the existing olive cultivars in the World has been a permanent challenge in olive growing, already stated by the classical Greek-Roman authors. In modern times, cataloguing cultivars has been a permanent objective in all olive countries. Successive Data Bases elaborated by Bartolini et al. for FAO are based on exhaustive bibliographical reviews of publications over more than 200 years. These Data Bases are the most complete inventories of the olive cultivar denominations in the World. The major, jet unsolved. The problem is the permanent confusion between denominations and authenticated cultivars correctly designated. For instance, in the 2005 version of Bartolini et al. on-line publication, the authors listed 94 collections in 26 countries with 4260 accessions from which 584 had the label "Unknow". The others (3676 accessions) corresponded to only 710 different denominations.

Therefore, to solve this confusion must be a compulsory initial step for cataloguing cultivars. To do so, the main criterion to be applied should be the uniqueness of any cultivar (a concept associated to a consistent universal agronomic expression of the same genotype). The present and future Seminars of the IOC Network of Germplasm Banks are aimed to debate and reach to agreements regarding olive identification protocols and the basic terms used in these processes.

Propagation of olive cultivars has drastically changed over the last 50 years. New methods of self-rooting cuttings under mist have replaced the old traditional ones, generally consisting in the propagation by the local farmers of big sized propagules for rooting or grafting on adult trees. The new propagation methods have been quickly adopted by a global olive nursery industry that currently provides most of the plants for the new olive orchards in the World. Consequently, a mayor problem has emerged: the spreading of not true to type cultivars and devastating diseases along with the commercialized plant material. For instance, the commercialization of infected plants has been vehicular for *Verticillium* wilt spreading in olive orchards worldwide. Also, the *Xylella* outbreak in Puglia (Italy) was originated by non-controlled commercialized plants between countries.

Therefore, the production of true to type and free from pest and diseases plants according to the EPPO protocol has become mandatory for the olive sector. To address this problem, different countries are reviewing their protocols for plant certification. The IOC Network of Germplasm Banks will require true to type and healthy plant material to be exchanged between the member banks. In a first step the THOC (True Healthy Olive Cultivars), a joint Project of the IOC and the UCO, will accomplish the authentication and sanitation of the 101 most propagated cultivars in the olive growing countries. Plant material of these 101 cultivars will be available for all the Germplasm Banks upon request, according to the protocol established by the IOC. The cost of this exchange of material will be supported by the demanding Bank.

In summary the goals of this Seminar are to:

- **Review the current status of the banks of the IOC network.**
- **Define and adopt a protocol for the management and cataloguing of the olive cultivars of the IOC Network.**
- **Present the status of the THOC project and the scheduled activities.**
- **Propose new joint activities.**

Current status of the IOC network of germplasm banks:
The IOC Network of Germplasms Bank.
A*bdelkrim Adi* (IOC)

The genetic heritage of the olive tree has evolved over centuries through farmers' selection. The various ways to use and conserve this age-old species are currently being studied at the University of Córdoba (UCO), with the assistance of the network of germplasm banks of the International Olive Council (IOC). An agreement was signed between the two institutions to work together on this subject, as part of the TRUE HEALTHY OLIVE CULTIVARS (THOC) project.

The IOC network of germplasm banks was created as part of the RESGEN project in 1994. The network has grown substantially since then, and currently holds varieties from all over the world, including: Albania, Algeria, Argentina, Croatia, Cyprus, Egypt, France, Greece, Iran, Israel, Italy, Jordan, Lebanon, Libya, Montenegro, Morocco, Palestine, Portugal, Slovenia, Spain, Tunisia, Turkey and Uruguay. Syria had a collection in the past but, given the current political situation, their inclusion in the IOC network is not set in stone. Negotiations with several other IOC countries are in progress. There are international collections in the germplasm banks of Córdoba, Marrakech and Izmir, three very different environmental geographies. The IOC network currently holds more than 1 700 accessions, over 1 000 of which have been authenticated on both the morphological (UPOV_COI) and molecular (SSRs) levels.

In recent years, the spread of *Verticillium dhaliae* and the *Xylella fastidiosa* outbreak in Puglia (Italy) have made it more important than ever to ensure that only plant material that is free from pests and diseases are being traded on the international market. The banks on the network are currently most focused on authenticating and sanitising all accessions as quickly as possible.

To this end, the THOC project has established a common guide to authentication, diagnosis, sanitation and the exchange of plant material between banks. This guide will first be tested with the 101 most important cultivars of the countries represented in the network. In the near future, a coordinated project will be proposed to extend the following for all accessions on the network:

1. The plant material is authenticated and free from pests and diseases;
2. Plants are tested to verify the absence of the pests and diseases included in EU and EPPO regulations;
3. A common online database will be available on the IOC website;
4. Free exchange of true to type and healthy cultivars among banks; and
5. The banks must be funded by the country's responsible institutions.

The IOC will coordinate the network, promote international partnership with FAO and other international institutions and stakeholders, facilitate continuous information on olive genetic resources via an online bulletin, and organise annual seminars for the banks on the network.

❖ Albania

Aulona Veizi

Location : Albania

Albania in 2017 possesses 12 million trees on the area of about 55 thousand hectares.

In Albania, the diversity of the Olea family reflects the quantity, variety and diversity of varieties, forms and biotypes. It provides the trait resources to improve yield, quality, pest and disease resistance and adapt to changing environmental conditions.

Accessions (number, origin, and denominations)

Variety is the most important factor of production. Over 60 varieties cultivated in Albania have been identified. Of these 14 varieties cover about 82% of the surface with olives, while only 8 varieties (7 indigenous) are the most cultivated:

An important goal is to create an ex situ (National Inventory) database of the most important or endangered genotypes. Overall 205 accs were explored while 144 accs were collected.

National Inventory; ex situ: 92 accessions (genotypes in total), ALB027 = 63 accessions. ALB020 = 29 accessions. collecting:

Table : Olive germoplasm is represented by 3 basic populations (wild and domesticated form). In Albania, 4 sub species were identified

Ssp.	On Farm	in situ	ex situ
Olea europeae ssp.sativa	47	164	177
Olea europeae ssp.oleaster	17	31	5
Olea europeae ssp.sylvestris	-	8	0
Olea europeae ssp.cuspidata	-	1	0
Total	64	205	182

Note: ex situ conservation consists of 84 native and 91 foreign cultivars

In Albania, 4 subspecies have been identified: Olea europeae ssp. sauva, Olea europeae ssp. oleaster, Olea europeae ssp. sylvestris Olea europeae ssp. cuspidata (African ssp. = 1 ace. in southern Albania).

Morphological (UPOV-IOC descriptors) characterization

There are currently 64 morphological databases available and considered useful in genetic diversity studies. The methodology used to describe olive biodiversity has considered a series of 32 morphological characters possessing variability, namely: tree; leaf; flowers; fruit: and endocarp. Basic descriptors are considered UPOV and Rezgen project.

Molecular (particularly SSR) characterization

According to the molecular protocol 44 autochthonous olive varieties were collected from both collections instead of germplasm. Samples were analyzed from 14 SSR and SSRr micro-satellite loci. Whereas 38 varieties were analyzed by micro-satellite SSR from Innocenzo Muzzalupo, Italy.

Identification and authentication, homonyms, synonyms, incorrect denominations and molecular variants

Principal name	N° Synonyms per Principal name			N° homonyms per principal name		
	Literatura	Morpholog analysis	SSR Analysis	Literatura	Morpholog analysis	SSR Analysis
Kaninjot Population	23	7	7	-	8	7
White olive Population	31	6	6	-	5	4
Two Populations	54	14	13	-	13	11

Albanian literature represents about 31 synonyms of the populations of the UB Tirana variety and 23 of the Kaninjot variety. searches in the last 10 years proved About 11 resulting homonymous individuals are called by the same name, but in fact they have changed and represent polymorphism with one or more specific profiles in morphological and molecular studies.

Diagnosis and health status of plants

There were no traces of the virus in the serological tests by ELISA in the samples of 22 autochthonous variants for the viruses: (ArMV), (CMV), (SLRSV), (OLYaV), (CLRV). Simultaneously with molecular

diagnosis (dsRNA, and RT-PCR). Analysis carried out in Bari Italy for primary sources of olive propagation.

Significant publications specifically addressed to characterization, cataloging, identification and authentication of cultivars

Ismaili H., Lani V., Ruci B. 2016. **Old Olive Inventory in Adriatic and Ionian Coast of Albania**. Int.J.Curr.Microbiol.App.Sci. 5(5): 502-511. doi: ttp://dx.doi.org/10.20546/ijcmas.2016.505.052

Innocenzo Muzzalupo, Antonella Muto, Giuliana Badolati, Aulona Veizi, Adriana Chiappetta,.·**2018 : Genotyping of Albania olive (*Olea europaea*) germplasm by SSR molecular marker.** Emirates Journal of Food and Agriculture. 2018. 30(7): 573-580. doi: 10.9755/ejfa.2018.v30.i7.1740

Hairi Ismaili., Aulona Veizi., Vasil Lani. **2018: Collection and Assessment of Olive Biodiversity.** Int. J. Curr.Microbiol.App.Sci. 7(08). 1716-1726. doi:https://doi.org/ 10.20546/ijcmas.2018.708.196

Hairi Ismaili[1], Belul Gixhari[1], Benard Ruci.2013: **Assessment of the olive territory thrung bio-morphological and geographical analysis**. Albanian j. agric. sci. 2013;12 (4): 715-719 ISSN: 2218-2020, © Agricultural University of Tirana

Aida Dervishi., jerney jakse., Hairi Ismaili., Branka Javornik, natasa Stajner. 2018 **Comparative assessment of genetic diversity of albanian olive (olea europaea L.) using SSRr from anonymous and transcribed genomic regions.**Tree Genetics &Genomes (2018) 14:53 https://doi.org/10.1007/s11295-018-1269-6

❖ Algeria

Khaled Rebiha

1. Caractéristiques du site

La Collection Oléicole Nationale, de l'Institut Technique de l'Arboriculture Fruitière et de la Vigne, est localisée sur les abords de la localité Takerietz et du village Taghzouth entre la Route Nationale N° 26 et la vallée du Soummam dans la commune de Souk Oufella ; au sud est Daira de Chemini ; à 3 Km Ouest de Sidi-Aich et une cinquantaine de kilomètre au sud-ouest du Chef lieu de la Wilaya de Bejaia.

la Ferme de Démonstration ITAF de Takerietz est placée dans la zone médiane de la vallée de Soummam qui se rétréci considérablement dans les défilés de sidi Aich et Takarietz. Cette zone est située à une altitude de 179 mètre par rapport au niveau de la mer. Les coordonnées géographiques de la ferme, au point central, valent respectivement (latitude : 36° 25' 27,93'' Nord et longitude : 4° 31' 23,49''Est

Le sol est, constitué essentiellement de limons, de sables et des niveaux argileux favorisant la formation des terrasses alluviales. La région de Takerietz jouit d'un climat méditerranéen, elle bénéficie des précipitations abondantes, régulières et reparties sur neuf à dix mois de l'année où la pluviométrie moyenne annuelle avoisine les 600 à 700 mm et la température moyenne annuelle atteint 22,38°C (la moyenne des températures maximales du mois le plus chaud est de 29,30°C, celle des minimales du mois le plus froid est de 7,76°C),la région de Takerietz est également exposée aux vents secs. Ces facteurs climatiques place la région de sidi Aich dans l'étage bioclimatique humide à hiver froid caractérisé par une saison pluvieuse qui coïncide avec la neige, la saison sèche étant courte et peu marquée, le terroir peut être intéressant car son climat est très différent des autres régions climatiques d'où pousse l'olivier sous régime pluvial.

La collection s'étend sur une Superficie de 9 ha 66 ares soit 23,85% de la Superficie Agricole Utile de ferme. L'oliveraie (Parcelle N° I) est composée de cinq (5) carrés répartie en : a) Carré de Conserve ; b) Carre Algérien ; c) Carré Italien, Carré divers et Carré de la variété ''Chemlal''

2. Données sur la collection

L'implantation du verger a été commencée entre 1952 et 1956 et les 178 variétés sont réparties en variétés à huile, variétés de table et des variétés mixtes. Tous les plants sont obtenus par greffage, plantés en carrée selon leurs origines et conduits en gobelet classique. Chacune des variétés est représentée par quatre plants qui bénéficient de pratiques culturales identiques. La disposition des arbres est uniforme et en lignes. Cependant, la densité la densité de plantation est variable entre (8x7m) et (10x10m) soit de 100 à 178 plants/hectare.

Les techniques culturales réservées au verger sont réduites à une taille d'entretien pratiquée annuellement et rarement une fois tous les deux ans, elle se fait juste après la récolte et avant

l'apparition des bourgeons floraux. Trois discages annuels sont exécutés en automne, en printemps et en été pour la lutte contre les mauvaises herbes, le verger est conduit sous régime pluvial et bénéficie de 2 à 3 irrigations durant la période estivale (juillet mi-septembre) surtout le carré des variétés de conserve, un plan de fumure et le traitement contre la mouche d'olive (bractocera oléa)

3. Assortissement variétal (accessions)

L'inventaire initial de Hauville (1953), indique 150 variétés d'oliviers plus ou moins cultivées. A la très grande diversité du matériel végétal, vient s'ajouter la confusion au niveau des noms donnés aux variétés. A ces difficultés de dénominations viennent s'ajouter des homonymies de noms pour des variétés très différentes.La collection de Sidi Aïch, installée en 1952, regroupait 151 variétés dont 35 variétés algériennes et 116 introduites. Initialement, il y avait 40 variétés algériennes, mais le débordement de l'oued Soummam en 1957, a entraîné la disparition de 5 variétés. Actuellement, la collection regroupe **174** variétés dont **36** locales et **138** étrangères introduites à partir d'Italie ; France ; Grèce ; Portugal ; Tunisie ; l'Espagne ; Turquie ; Jordanie ; Palestine ; Liban ; Chypre et USA

4. Caractérisation morphologique (descripteurs COI)

À partir de 1952, une gamme variétale a été identifiée et conservée, le projet CCF/IOC/03 intitulé '***Conservation, Caractérisation, collecte et utilisation des ressources génétiques de l'olivier (baptisé RESGEN)*** ayant pour objectif l'identification, la description et la conservation du patrimoine génétique de l'olivier et l'introduction des différents génotypes dans des banques nationales et internationales de germoplasme dont les travaux dudit projet ont débuté le mois de Septembre 1997, ont permis à notre centre :

- Enregistrement des données de passeport des variétés de la collection.
- Caractérisation primaire et secondaire des variétés de la collection.
- Prospection et caractérisation primaire de 35 dénominations nouvelles repérées au niveau des trois régions (Est, Centre et Ouest)

La méthodologie du travail a été proposée par le Conseil Oléicole International pour l'ensemble des pays participants, consistait à étudier 32 critères caractérisation primaire à savoir : Arbre : (3) ; Rameau : (1) ; Inflorescence : (2) critères ; Feuille : (4) ; Fruit : (11) ; Noyau : (11). Quant la caractérisation secondaire a étudié Le rapport pulpe / noyau ; La production moyenne en olives ; La teneur en huile et Le taux d'enracinement.

5. Identification et authentification, homonymes, synonymes, dénominations incorrectes et variants moléculaires

Le Projet CFC /IOOC/03 a permis à l'Algérie d'inventorier, caractériser et conserver 71 cultivars locaux de l'olivier dont 44 sont déjà transféré dans les deux collections mondiales de Cordoue et Marrakech. L'ITAF a pu étendre la gamme des variétés locales d'olivier autorisées à la commercialisation de 09 en 1995 à 36 en 2007.cependant, parmi eux 11 seulement sont

utilisés dans le développement avec une concentration de deux variétés principales en l'occurrence ''Chemlal'' pour la trituration et la ''Sigoise'' pour la confiserie.

Ainsi, L'ITAF a édité en 2006 un Catalogue des Variétés algériennes de l'olivier intitulé '' l'olivier en Algérie, aperçu du patrimoine génétique'' reprenant les données essentielles de passeport du Conseil oléicole International. Ce document synthétique à destination du grand public, des socioprofessionnels et des élus a suscité un intérêt très remarquable en mettant fin à l'aspect vernaculaire (dialectal) des dénominations. C'est aussi, la contribution à la mise en place de la collection de référence du Centre National de Contrôle et Certification des Semences et Plants en permettant au lancement de schéma de certification.

6. Caractérisation moléculaire (en particulier SSR)

Malgré les efforts déployés en vue de l'accomplissement de la caractérisation moléculaire et le nombre de tentatives pour l'acquisition du l'équipement, la formation du personnel en vue la maitrise de la technique, le laboratoire n'est pas encore opérationnel.

7. Les perspectives

Vu l'importance de cette collection et en vue de son rajeunissement et sa préservation des risques d'inondation et feux d'été , un programme de démultiplication a déjà commencé par :
La reconstitution de la nouvelle collection à la ferme de démonstration de Takerietz
La mise en place du conservatoire arboricole et viticole via des blocs est déjà entamée depuis 2009 et le Bloc Olivier a vu la plantation de 55 variétés dont 24 autochtones et 31 étrangères
La mise en place d'une collection régionale de 46 variétés de conserve à FD Mohammadia (ouest d'algerie) et de 10 variétés d'olives à huile à FD Skikda (est Algérien)

Quant à l'utilisation, le projet CFC/IOC/09 (2013/2018) intitulé ''***Valorisation Economique des Ressources Génétiques de l'Olivier et création de centres pilotes de pépinières de démonstration"*** a permis de mettre en place deux réseaux ; le premier concernera les parcs à bois qui servira comme source d'approvisionnement des pépinières agréées et le second portera sur le comportement des variétés autochtones dans différents sites en vue d'étudier les performances agronomiques et technologiques des cultivars en dehors de ses terroirs d'origine ce qui permettra non seulement de recueillir un certain nombre d'informations utiles , à caractère stratégique, sur son adaptabilité dans différentes zones agro-écologiques mais aussi d'orienter le choix de tout nouvel développement des ces zones.

En ce qui concerne le volet certification, les pouvoirs publics ont priorisé le développement de l'activité de production des plants et le renforcement du rôle des pépinières en adaptant une série de mesures pour lancer le schéma de certification des plants arboricoles et notamment les plants d'olivier par la révision de l'octroi d'agrément de pépinière sur la condition de disposition d'un PAB (le nombre a descendu de 530 à 39 pépinière) et l'appui à la mise en place d'une démarche qualité au sein des services de la protection des végétaux et de contrôles

techniques (DPVCT , CNCC et INPV) en vue de leurs l'accréditation selon la Norme ISO 17025 pour la fiabilité des résultats s'analyses et la Norme ISO 17020 pour un rapprochement des standards européens et internationaux.

8.Publications importantes, spécifiquement consacrées à la caractérisation, au catalogage, à l'identification et à l'authentification des cultivars (pas plus de 5)

En termes de publication, notre collection a servi comme support pédagogique pour les universitaires et chercheurs scientifiques, des étudiants et stagiaires en citant les thématiques les plus importants en l'occurrence :

Mendil M., SebaiA., 2006. Catalogue des variétés Algériennes de l'olivier,ed. Institut Technique de l'Arboriculture fruitière et de la vigne, Algérie.97p.

Bellal et Dozane M.2002 ; Caractérisation biochimique des huiles de quelques variétés population d'oliviers locales. Mémoire de magister INA El Harrach-170p.

HADJ SADOK Tahar, RABIHA Khaled et TERKI Djamila : Caractérisation physico-chimique et organoleptique des huiles d'olive vierges de quelques variétés algériennes Revue Agrobiologia (2018) 8(1): pp 706-718

KECIRI Sonia: Effect of olive knot on olive oil quality in Algeria

Monia MEZGHACHE ; Cherifa HENCHIRI ; Lucy MARTINE ; Olivier BERDEAUX ; Noureddine AOUF et Pierre JUANEDA : Contribution à l'étude de la fraction insaponifiable de trois huiles d'olive issues des variétés Guasto, Rougette et Blanquette plantés dans l'est algérien, revue fondamental OCL VOL. 17 N° 5 SEPTEMBRE-OCTOBRE 2010 ,pp 337-344

❖ Argentina

Mariela Torres

1. General information about the germplasm collection

a. Name of the institution in charge:**Instituto Nacional de Tecnología Agropecuaria**

b. Location, geographic coordinates and address of the institution in charge:

Instituto Nacional de Tecnología Agropecuaria (INTA). Estación Experimental Agropecuaria San Juan. Ing. Marcos Zalazar (Calle 11) y Vidart. Villa Aberastain, Pocito. C.P.: 5427. San Juan. Tel.: 0054(0264)4921079

c. Geo-location of the institution in charge

Estación Experimental Agropecuaria INTA San Juan: 31º39' S, 68º35' W, Departamento Pocito – San Juan.

d. Scientist in charge (name, post, telephone number and e-mail)

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2. Field collection

The climate of the area is arid, with an average annual rainfall of 90 mm, mostly concentrated in the summer. The absolute maximum temperatures exceed 40° C, while the absolute minimum temperatures vary between 5ºC and 10ºC below zero. There is an important thermal amplitude, annual and daily, being this the highest in Argentina.

The soils of this region are generally characterized as being young and undeveloped with little evolution towards pedogenetic horizons. They are poor in organic matter, but it has high total potassium reserve and medium content of available phosphorus. They are classified as Entisols and are constituted by gravitational, wind and fluvial sediments (Moscatelli et al., 1990), with a sandy-loam surface layer and a deeper sandy layer. The fertilization of the olive grove is

biannual, applying 500 g N per tree. They are grown under irrigation (600 mm water/year) plus natural rainfall.

i. Area 1: *Dante Floreal Marsico (1944)*
- Location (address and geographic coordinates): Campo Anexo San Martín (CASAM) - Estación Experimental Agropecuaria INTA San Juan (31°30′ S 68°17′ W, Departamento San Martín – San Juan).
- Hectares: 6. Planting distances: 10 x 10 m.

ii. Area 2: *INTA EXPONE* (2015-16)
- Location: Campo Anexo San Martín (CASAM) - Estación Experimental Agropecuaria INTA San Juan (31°30′ S 68°17′ W, Departamento San Martín – San Juan).
- Hectares: 0.5. Planting distances: 6 x 5 m.

ii. Area 3: *Unnamed* (2019 - in expansion)
- Location: Campo Anexo San Martín (CASAM) - Estación Experimental Agropecuaria INTA San Juan (31°30′ S 68°17′ W, Departamento San Martín – San Juan).
- Hectares: 8. Planting distances: 7 x 3.5 m.

3. Accessions (see attached list currently available to IOC)

Denomination of accesion	**Origin**	**MOLECULAR IDENTIFICATION (SSRs)***	**MORPHOLIGICAL DESCRIPTION**
Alameño de Montilla	Spain	NO	YES
Aloreña	Spain	YES	YES
Arauco	Argentina	YES	YES
Arbequina	Spain	YES	YES
Arbosana	Spain	YES	YES
Arroniz	Spain	NO	YES
Ascolana Tenera	Italy	YES	YES
Barnea	Israel	NO	YES
Bella di Cerignola	Italy	NO	YES
Biancolilla	Italy	NO	YES
Blanqueta	Spain	YES	YES
Borgiona	Italy	NO	YES
Callosina	Spain	NO	YES
Canino	Italy	YES	YES
Capolga	Italy	YES	YES
Carolea	Italy	NO	YES
Carrasqueño de Alcaudete	Spain	NO	YES
Cerasuola	Italy	NO	YES

Denomination of accesion	Origin	MOLECULAR IDENTIFICATION (SSRs)*	MORPHOLIGICAL DESCRIPTION
Changlot Real	Spain	YES	YES
Chetoui	Tunisia	NO	YES
Cipressino	Italy	YES	YES
Cobrançosa	Portugal	NO	YES
Coratina	Italy	YES	YES
Cornicabra	Spain	NO	YES
Coroncina	Italy	NO	YES
Curivell	Spain	NO	YES
Dritta	Italy	NO	YES
Empeltre	Spain	YES	YES
Frantoio	Italy	YES	YES
FS 17	Italy	NO	YES
Genovesa	Spain	YES	YES
Giarraffa	Italy	NO	YES
Gordal sevillana	Spain	NO	YES
Hojiblanca	Spain	YES	YES
Itrana	Italy	NO	YES
Kalamon	Greece	NO	YES
Koroneiki	Greece	YES	YES
Leccino	Italy	YES	YES
Leccio del Corno	Italy	YES	YES
Lechin de Sevilla	Spain	NO	YES
Limona	Italy	NO	YES
Manzanilla de agua	Spain	NO	YES
Manzanilla de Sevilla	Spain	NO	YES
Mastoidis	Greece	NO	YES
Maurino	Italy	YES	YES
Moraiolo	Italy	NO	YES
Moresca	Italy	NO	YES
Negrillo de Arjona	Spain	NO	YES
Nocellara del Belice	Italy	YES	YES
Nocellara Messinese	Italy	NO	YES
Nostrale di Rigali	Italy	NO	YES
Ocal	Spain	NO	YES

Denomination of accesion	Origin	MOLECULAR IDENTIFICATION (SSRs)*	MORPHOLIGICAL DESCRIPTION
Orbetana	Italy	NO	YES
Ortice	Italy	NO	YES
Pajarero	Spain	NO	YES
Pequeña de casa Ibañez	Spain	NO	YES
Piantone di Falerone	Italy	NO	YES
Piantone di Mogliano	Italy	NO	YES
Picholine du Languedoc	France	NO	YES
Picholine marrocaine	Morocco	NO	YES
Picual	Spain	YES	YES
Pignola	Italy	NO	YES
Pocciolo	Italy	NO	YES
Racimal de Jaén	Spain	NO	YES
Redondilla de Logroño	Spain	NO	YES
Royal de Cazorla	Spain	NO	YES
San Benedetto	Italy	NO	YES
Taggiasca	Italy	NO	YES
Tonda Iblea	Italy	NO	YES
Verdello	Italy	NO	YES
Verdial de Veléz Málaga	Spain	NO	YES
Villalonga	Spain	YES	YES

* DCA3, DCA9, DCA16; DCA18; GAPU71B; GAPU101; GAPU103

The international olive collection in Argentina also has 97 accessions that are still unknown. Some of these accessions have molecular marker data. In addition, many of these accessions have morphological description.

4. Diagnosis and health status of plants

In this collection, no significant disease problems are recorded. Particularly, the olive fly does not constitute a pest of interest in this region. As a preventive action, a systemic insecticide is applied twice a year to control the cochineal (*Pollinia pollini*).

5. Prospects

Our work is to continue expanding the Collection with new olive cultivars. Likewise, we will continue advancing in the molecular characterization (SSRs) of cultivars that still have no record. On the other hand, we are interested in evaluating agronomic behavior in relation to the environment (genotype x environment).

6. Publications

1. Romina Bodoira, Mariela Torres, Pierluigi Pierantozzi, Agnese Taticchi, Maurizio Servili, Damián M Maestri. 2015. “Oil biogenesis and antioxidant compounds from “Arauco” olive (*Olea europaea* L.) cultivar during fruit development and ripening”. European Journal of Lipid Science and Technology 117: 377-388.

2. Romina Bodoira, Mariela Torres, Pierluigi Pierantozzi, Fernando Aguate, Agnese Taticchi, Maurizio Servili, Damián Maestri. 2016. Dynamics of Fatty Acids, Tocopherols and Phenolic Compounds Biogenesis during Olive (*Olea europaea* L.) Fruit Ontogeny. J. Am. Oil Chem. Soc. (2016) 93:1289–1299.

3. Mariela Torres, Pierluigi Pierantozzi, Peter Searles, M. Cecilia Rousseaux, Georgina García-Inza, Andrea Miserere, Romina Bodoira, Cibeles Contreras, Damián Maestri. 2017. Olive Cultivation in the Southern Hemisphere: Flowering, Water Requirements and Oil Quality Responses to New Crop Environments. Front. Plant Sci. 8:1830. doi: 10.3389/fpls.2017.01830.

4. Soraya Mousavi, Raul de la Rosa, Abdelmajid Moukhli, Milad El Riachy, Roberto Mariotti, Mariela Torres, Pierluigi Pierantozzi, Vitale Stanzione, Valerio Mastio, Hayat Zaher, Abderraouf El Antari, Salam Ayoub, Faten Dandachi, Hiyam Youssef, Nikolas Aggelou, Cibeles Contreras, Damián Maestri, Angjelina Belaj, Marina Bufacchi, Luciana Baldoni, Lorenzo Leon. Plasticity of fruit and oil traits in olive among different environments (Aceptado, Scientific Reports).

5. XXXV Reunión Científica Anual, Sociedad de Biologia de Cuyo, “Evaluation of the genetic diversity of the olive collection (INTA SAN JUAN, Argentina) by morphological and microsatellite markers”, San Luis, Merlo, 6 al 7 de diciembre de 2017 (Contreras C., Gentili, L., Mariotti R., Cultrera N., Baldoni L., Mousavi S., Pierantozzi, P., Maestri, D., Torres M., Expositores).

❖ Croatia

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The Institute for Adriatic Crops and Karst Reclamation is Croatian public research institute. It is based in Split, and has about 50 employees. Research of fruit species, grapevine, vegetables, medicinal and aromatic plants is one of the basic activities of the Institute. In addition to gathering and establishing collections, the institute has been intensively working on their evaluation starting from the development and/or improvement of propagation and growing techniques, studies of physiological processes in plants themselves, genetic characterization of species/cultivars, molecular and biochemical indicators to the extensive physical-chemical, biochemical and sensory analysis of fruits and their products.

At its experimental plantations, the Institute maintains the collection of olive cultivars from the main olive producing countries of the world, collected mostly through UNDP/FAO project (1978–1992), as well as the collection of the national cultivars. The most commonly nationally planted cultivars, and among them the most commonly exchanged among IOC network countries are presented in our sixty year old olive collection situated in Kaštel Stari (43˚33'22"N, 16˚20'56"E). It consists of four cultivars, 'Oblica', 'Lastovka', 'Levantinka' and 'Drobnica', represented with 72 trees. 'Oblica' is the most widespread and the most important cultivar in Croatia. This is the cultivar with the highest number of synonyms used throughout the cultivation area of Croatia, such as: orkola, orkula, orbula, debela, sladunica, domaća, trognja, trgulja, balunjača, etc. Alternate bearing is an important characteristic of this cultivar. 'Lastovka' is autochthonous Croatian oil cultivar originated from the western part of the island of Korčula, where it is the leading variety. 'Levantinka' is an oil cultivar that is grown mainly on the island of Šolta. This cultivar is highly self-compatible and has regular bearing.

The study of the morphological characteristics of 'Oblica', 'Lastovka' and 'Levantinka' has revealed significant differences. With respect to *tree characteristics*, the following characteristics of 'Lastovka', 'Levantinka', 'Oblica' have been observed: medium vigour, spreading growth habit and medium canopy density. Regarding the *leaf characteristics*, 'Oblica' has the elliptic shape of leaf, of medium length, broad width and the helicoid leaf blade. In 'Lastovka', the leaf is elliptic, of short length, medium width and has flat leaf blade. 'Levantinka' has elliptic leaf of medium length, with broad width and hyponastic leaf blade. All cultivars have *inflorescences* of medium length. 'Lastovka' and 'Oblica' have low number of flowers per inflorescences and this number is medium in 'Levantinka'. Regarding the *fruit characteristics*, the fresh weight of fruit is very high in 'Oblica' but medium in 'Lastovka' and 'Levantinka'. Apex and base position of the fruits are rounded in all cultivars with the exception

of ‘Levantinka’ that has pointed apex position. The fruit shape is spherical in ‘Oblica’ and elongated in ‘Lastovka’ and ‘Levantinka’. The weight of *endocarp* is medium in ‘Oblica’ and ‘Lastovka’ but high in ‘Levantinka’. The shape of endocarp is elliptic and slightly asymmetric in ‘Oblica’ but elongated and asymmetric in other two cultivars. The base of endocarp is pointed in all cultivars. The apex is rounded in ‘Oblica’ and ‘Lastovka’, and pointed in ‘Levantinka’. At the start of the ripening period, the first violet blotches appear on the epidermis of the fruit from the apex in ‘Lastovka’ and ‘Oblica’ but from the base in ‘Levantinka’. Colour of the fruits at the full maturity is black in ‘Levantinka’ but not in other two cultivars.

The incidence of the most frequent pests and diseases in the collection is usually determined by visual inspection of the trees throughout the year or by molecular testing of the presence of specific pathogens. The plants in the collection have been renewed four years ago so they are in a quite good condition. Regarding the plant health status and diseases, the symptoms of the olive leaf spot periodically appear while the olive knot disease is present in the varying intensity during the year in particular trees. Cultivar ‘Lastovka’ shows high susceptibility to olive knot disease, more than any other cultivar in the collection. Two bacteria species have been isolated from the olive knots, *Pantoea* sp. isolate *paga* and *Pseudomonas sp.* and the complete genome sequence described and deposited at NCBI /GenBank.

Different molecular markers were used in our experiments and employed in the genetic characterization of cultivars. Recently, SSRs were markers of choice in genotyping and have been employed in paternity testing and identification of pollen donors. The following microsatellite loci (SSRs) were selected on the basis of other researchers’ experience and used in our experiments: DCA3, DCA5, DCA7, DCA9, DCA11, DCA14, DCA15, DCA16, DCA18 (Sefc et al., 2000), EMO3, EMO90 (De la Rosa et al., 2002), GAPU101, GAPU103A, GAPU71B (Carriero et al., 2002) and UDO99-19 (Cipriani et al. 2002).

Regarding the prospects, the Institute aims at continuing in the ongoing scientific research activities, which relate to preservation of indigenous genetic fund and its evaluation through the maintenance of the existing collections, and permanent work on gathering, collecting and evaluating the most important olive cultivars. This research activity has been initiated with the RESGEN project in 1996 and has been maintained until today through many different projects. Today in the institute the olive research group consists of ten researches including agronomists, biologists, food scientists and plant pathologists. The Institute has just completed two olive projects, one aiming to understanding of the compatibility relationships and pollen-pistil interactions in olive, and another one related to elemental and isotopic composition of the olive as basis for oil geographic traceability. At the moment, the Institute is contracted partner in Centre of Excellence for Biodiversity and Molecular Plant Breeding (CroP-BioDiv), responsible for WP Olive.

Publications:

Vuletin Selak G, Perica S, Goreta Ban S, Bućan L, Poljak M (2012) Flower sterility and the germination ability of pollen as genetic traits of seven olive (*Olea europaea* L.) cultivars grown in Croatia. Journal of horticultural science & biotechnology, 87, 3: 237-242.

Vuletin Selak G, et al. (2011) Reproductive Success Following Self-pollination and Cross-pollination of Olive Cultivars in Croatia. HortScience, 46(2): 186-191.

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Strikić F, Bandelj Mavsar D, Perica S, Čmelik Z, Šatović Z, Javornik B (2009) The main Croatian olive cultivar "Oblica", shows high morphological but low molecular diversity. Journal of Horticultural Science and Biotechnology. 3: 345-349.

Rošin J, Vuletin Selak G, Strikić F, Perica S (2004) Morphological characteristics of the most important Croatian autochthonous olive (Olea europaea L.) cultivars. Book of Abstracts, 5th International Symposium on Olive Growing, p. 119, Izmir, Turkey.

❖ Cyprus

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The Agricultural Research Institute (ARI) is a Department under the Ministry of Agriculture, Rural Development and Environment, of the Republic of Cyprus. The vision of the ARI is to be a model center of knowledge and innovation, and lead Cyprus to a better future by strengthening rural development, improving the quality of life, and ensuring the sustainable use of natural resources.The ARI conducts research aiming to create and transfer knowledge for the development of the primary sector and to solve problems at the farmer's level. The research results are transferred to stakeholders through modern educational programs and dissemination tools. Its research activity strengthens rural development and contributes to the adoption of a sustainable rural policy and innovation offer.

Olive Technology Laboratory (OTL) of ARI's Fruit Trees Department carries out research on olive sector including evaluation of olive cultivars in the agro-environmental conditions of Cyprus, characterization and identification of olive genetic material, evolution of qualitative characteristics of olive products through ripening and postharvest, olive oil technology and configuration of extra virgin olive oil sensory and chemical profile.

The Olive Collection of Agricultural Research Institute (OCARICY) includes mainly local olive genetic material from Cyprus. It was collected during the principle systematic prospection study conducted on indigenous olive germplasm from Cyprus which wassolely focused on the clonal selection of the cv. Ladoelia, considered as the main local variety (Gregoriou, 1996, 1999). OCARICY established upon the completion of the above project and is located at ARI's Tochni Experimental Station(34° 44′ 00″N; 33° 20′ 15″E) of Tochni village in Larnaca district. In total, 33 accessions are included in OCARICY from which only two are foreign cultivars ('Picual' from Spain and 'Koroneiki' from Greece). The rest 31 accessions originate from Cyprus and aside from their numerical identifier codes, names designated the geographical region of origin were assigned to them.

Morphological description of the accessions started directly after their establishment in OCARICY and reinforced by the implementation of RESGEN project (Gregoriou, 1996, 1999) and a partial molecular characterization with random amplified polymorphic DNA markers (Banilas et al., 2003) of only some accessions. Recent analysisbased on the integrated use of morphologicaland molecular markersto facilitate the identification of olive cultivars (Trujillo et al., 2014) using 11 morphological endocarp traits [(described by Barranco et al. (2000, 2005)

and adopted by UPOV (2011)] and 14 SSR markers [ssrOeUA-DCA3, ssrOeUADCA9, ssrOeUA-DCA11, ssrOeUA-DCA15, ssrOeUA-DCA16, ssrOeUA-DCA18 (Sefc et al., 2000), GAPU-59, 71B, 101, 103A (Carriero et al., 2002), UDO99-011, 019, 024, and 043 (Cipriani et al., 2002)] has been applied to local olive genetic material present in OCARICY and allowed their identification (Emmanouilidou et al., 2018).The identification, based on the unique combination of SSR genotypes and endocarp morphologies, revealed the presence of three cultivars ('Kato Drys', 'Korakou' and 'Ladoelia') and 15 molecular variants. Two cultivars, 'Ladoelia' and 'Kato Drys', demonstrated molecular variation.

ARI upon request by the Department of Agriculture and under implementation of the National Register of Commercial Varieties has installed a candidate pre basic mother plantation including initial genetic material from OCARICY. Candidate pre basic mother plants have been tested for *Arabis mosaic virus* (ArMV), *Cherry leaf roll virus* (CLRV), *Strawberry latent ring spot virus* (SLRSV), *Cucumber mosaic virus* (CMV) and no presence of these viruses has been confirmed.

The recent progress onlocal olive genetic material studies not only paved the way for the diffusion of authenticated and healthy olive cultivars and future enrichment of OCARICY with other genetic material, but also laid the foundations for the implementation of further studies on local cultivars, permitting the optimum exploitation of cultivar specific characteristics for the production of olive products of high quality and nutritional-organoleptic value. OTL's main active research project is dealing with the cultivar modulated maturity evolution as well as the qualitative characteristics of olive fruit, olive paste and olive oil of Cypriot cultivars aiming to accentuate their particularities and enhance their use.

Relevant publications:

Emmanouilidou, M.G., Kyriacou, M.C., Trujillo, I., 2018, Characterization and Identification of Indigenous Olive Germplasm from Cyprus Using Morphological and Simple Sequence Repeat Markers, HortScience 53(9), 1306-1313. https://doi.org/10.21273/HORTSCI13192-18

Banilas, G., J. Minas, C. Gregoriou, C. Demoliou, A. Kourti, and P. Hatzopoulos.2003. Geneticdiversity among accessions of an ancient olive variety of Cyprus. Genome 46:370–376.

Gregoriou, C. 1999. Clonal selection of "Local" olive variety of Cyprus. Olivae 76:26–30.

Gregoriou, C. 1996. Assessment of variation of landraces of olive tree in Cyprus. Euphytica 87:173–176.

❖ Egypt

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Location: Horticulture Research Institute – Agricultural Research Center

- Olive Department (Horticulture Research Institute) has more than 50 researchers and researcher assistants specialized in olive both growing and production, implemented many researches in olive (Propagation, Pruning, Fertilization, Irrigation, Environmental Stress, Chilling requirements and Cultivars Evaluation., etc). Moreover, participated in national and international projects since 1982 and cooperated with IOC in many of these projects.
- One of the most important projects was (Conservation, Characterization, Collection and Utilization of The Genetic Resource project) in collaboration with the International Olive Council (IOC) and Common Found for Commodities (CFC) during the period from 2001 to 2006 (**RESGEN CFC/ IOOC/003)**, which revealed many of the Egyptian germplasm in different regions in Egypt.

The following table clarified these cultivars and some information about each one:

No.	Accessions	Origin & district	Use	Importance
1	Aggizi Shame	Fyoum	Table	20%
2	Aggizi Akse	Fyoum	Table	5%
3	Aggizi Oshime	Fyoum	Table	-
4	Hamed	Siwa	Table	6%
5	Wateken	Siwa	Dual	3%
6	Maraki	Siwa	Oil	6%
7	Toffahi	Fayoum	Table	6%
8	Balady	Fayoum	Table	-
9	El Salam	Fayoum	Table	-
10	Wardan	Giza	Dual	-

No.	Accessions	Origin & district	Use	Importance
11	Meloky	Siwa	Oil	0.5 %
12	Baid El Hamam	Fayoum	Table	-
13	Sebhawy	Arish	Oil	1%
14	Sinawy	Arish	Oil	0.5%
15	Cairo 7	Giza	Table	-
16	El Lewa	Fayoum	Table	-
17	Bez El Anza	Arish	Oil	-
18	Kosiem	Arish	Oil	-
19	Abou Monkar	Arish	Oil	-
20	Siwy*	Siwa	Oil	0.5%

* New accession (Siwy) was added to the list of Egyptian accessions by the end of the **Project RESGEN CFC/ IOOC/003.**

- In addition, There are many international cultivars which have been cultivated during the last 4 decades in Egypt and achieved the adaptability in different regions such as [Picual and Manzanillo (from Spain), Kalamata and Koronaiki (from Greece), Coratina (from Italy) and Dolce (unknown origin)].
- By the project RESGEN CFC/ IOOC/003 and several researches and thesis, the evaluation of all these previous cultivars (native and international ones) had be achieved through studying the primary and secondary characterization (morphological, phenological, maturation and oil determination) according to the descriptions of IOC.
- All trees were free of pathogens and physiological disorders and received the common culture practices concerning pruning, irrigation, fertilization program, and pest control as recommended by the Ministry of Agriculture. Furthermore, we have checked a lot of leaves samples from the mother plant trees of our accessions using real-time LAMP under supervision the FAO project (TCP/RAB/3061) which titled “Preventive Measures for the Introduction and Spread of *Xylella fastidiosa*- Olive Quick Decline Syndrome in NENA

Countries". By screening the under study samples, no symptoms were identified on any of those samples and all of them were found negative to *X. fastidiosa.*

- On the other hand, We used molecular markers to characterize all native accessions (which tabulated previously) and study genetic relationships between olive Egyptian cultivars. Microsatellites or simple sequence repeats (SSR) were isolated from olive using genomic libraries enriched in (AC) or (AG) repeats, and tested a panel of the native 19 accessions of different regions of Egypt in order to evaluate the degree of polymorphism of these markers. Beyond this identification, we constructed a molecular data base that can be used to make a reference collection of Egypt olive germplasm by comparing the molecular pattern of each identified accession with samples from different areas.

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Shepa, A. (2001). Comparative studies on some olive cultivars frown under different environmental conditions. Ph.D. thesis, Fac.Agric., Assuit Univ.

❖ France

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French olive accessions in the *ex-situ* collection of Porquerolles

The French Olive Germplasm Bank (FOGB) includes a total of 113 olive accessions, and is maintained on the island of Porquerolles, near Toulon in southern France (Table 1). These accessions are identified with a variety name and/or with tree coordinates in the collection (Table 1). Among the 63 accessions identified with a variety name, 14 are considered as being the main French varieties since they are cropped over broad areas compared to minor varieties (22), which have a limited distribution range, generally over a few townships, and to local varieties (27), which are only present in one or two orchards (Table 1). All these accessions were characterised using morphological UPOV-IOC descriptors (Moutier et al., 2004; 2011).

Molecular characterization using microsatellite markers

Twenty microsatellite nuclear loci (SSR) were used for genotyping French olive accessions (Table 2), as described by El Bakkali et al. (2013). These markers were selected based on their clear amplification, high polymorphism and reproducibility, as reported by Trujillo et al. (2014). Alleles were carefully scored twice independently by two researchers. Genotyping of accessions with a specific allele (i.e. observed only once) was systematically repeated to ensure its occurrence.

Genotypes of French accessions were compared to those of other varieties collected throughout the Mediterranean Basin. Four hundred and sixteen accessions from 13 Mediterranean countries that are maintained in the World Olive Germplasm Bank of Marrakech (WOGB)

Characterization of French olive germplasm and definition of reference genotypes per variety

One hundred and four distinct genetic profiles were obtained among the 113 accessions of the FOGB based on 20 SSR nuclear loci (Table 1). Closely related SSR profiles with one or two dissimilar alleles were considered as putative molecular variants resulting from somatic mutations and were thus classified as a single genotype. This was the case for ancient varieties such as 'Boube' or 'Négrette' and also for major varieties, such as 'Aglandau' or 'Cailletier', which are cultivated over broad geographic areas. The SSR profile considered as the reference genotype of the variety was chosen based on the high frequency of trees under the same molecular profile (Table 1). Hence, a total of 92 genotypes was defined among the 113 accessions analysed.

According to the methodology proposed by Khadari et al. (2003), a total of 63 varieties were validated as reference varieties by checking the morphological traits of olive stones and SSR profiles of several trees originating from different nurseries and orchards (Table 1). For instance, six trees of the 'Cailletier' variety from distinct origins were analysed to define the reference genotype (Moutier et al., 2004). Similarly, a total of 15 and 18 trees from different nurseries and orchards were analysed to validate the reference genotypes of the 'Petit Ribier' and 'Négrette' varieties, respectively (Moutier et al., 2004, 2011). The remaining 30 accessions, classified by tree coordinates in the germplasm collection, are currently being validated to determine the reference genotype of each variety according to the methodology described here (Table 1).

Comparison between French and Mediterranean olive germplasm

Based on pairwise analysis of the WOGB with 20 nuclear loci, 404 single SSR profiles (min. 1 dissimilar allele) were identified among the 416 Mediterranean olive accessions. Among the 86320 pairwise comparisons, 36 were identical (0.04%), 166 (0.19%) were closely related (differing by one or two dissimilar alleles), whereas the remaining were distinguished by three to 40 dissimilar alleles. Similar to the FOGB collection (see above), accessions showing identical profiles and those with one or two dissimilar alleles (molecular variants) were considered as belonging to the same genotype, leading to a total of 311 distinct genotypes among the 416 accessions analysed.

Pairwise comparisons between The French Olive Germplasm Bank and the World Olive Germplasm Bank of Marrakech revealed that eight French accessions were identical or closely related to 28 Mediterranean varieties (Table 3). Eighteen out of the 28 varieties originated from Italy, four from Lebanon, whereas the six remaining varieties were from Algeria (2), Spain (1), Cyprus (1), Greece (1), and Morocco (1).

Significant publications

El Bakkali, A., Haouane, H., Moukhli, A., Van Damme, P., Costes, E., and Khadari, B. (2013b). Construction of core collections suitable for association mapping to optimize use of Mediterranean olive (*Olea europaea* L.) genetic resources.*PLoS One* 8, e61263. doi:10.1371/journal.pone.0061263

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Moutier, N., Artaud, J., Burgevin, J.-F., Khadari, B., Martre, A., Pinatel, C., et al. (2011). Identification et Caractérisation des Variétés d'Olivier Cultivées en France. Tome 2. Turriers: Naturalia publications

Table 2. Genetic parameters of the 20 SSR loci in FOGB collection (92 genotypes). Number of alleles (N_a), number of private alleles (N_{pa}), expected (*He*) and observed heterozygosity (*Ho*), Polymorphism Information content (PIC)

N	Loci	FOGB					
		Size	Na	Npa	He	Ho	PIC
1	DCA01[a]	203-268	7 (1)[1]	2	0.568	0.620	0.520
2	DCA03[a]	229-250	7		0.841	0.935	0.814
3	DCA04[a]	128-192	20 (1)	6	0.875	0.674	0.856
4	DCA05[a]	189-209	11		0.614	0.685	0.587
5	DCA08[a]	123-154	15	6	0.795	0.891	0.765
6	DCA09[a]	160-207	18 (1)	6	0.873	0.913	0.855
7	DCA11[a]	125-179	11	5	0.788	0.913	0.752
8	DCA14[a]	168-186	9	1	0.636	0.641	0.604
9	DCA15[a]	242-265	4		0.519	0.489	0.443
10	DCA16[a]	121-175	10	2	0.815	0.615	0.786
11	DCA18[a]	162-182	10	1	0.815	0.870	0.788
12	GAPU59[b]	206-226	7	2	0.585	0.565	0.546

13	GAPU71A[b]	207-239	5	1	0.325	0.337	0.296
14	GAPU71B[b]	116-141	6	1	0.801	0.924	0.765
15	GAPU101[b]	181-215	8		0.851	0.967	0.828
16	GAPU103A[b]	133-188	14	3	0.827	0.867	0.802
17	EMO03[c]	201-215	11 (1)	4	0.767	0.707	0.727
18	EMO90[c]	180-193	5		0.710	0.837	0.666
19	UDO-017[d]	152-168	6		0.784	0.804	0.745
20	UDO-036[d]	140-164	7	2	0.683	0.739	0.625
	Mean		**9.55**		**0.723**	**0.749**	**0.688**
	Total		**191 (4)**	**42**			

[1]between brackets: number of specific alleles compared to the WOGB collection.
[a]Sefc et al., 2000, [b]Carriero et al., 2002, [c]De la Rosa et al., 2002, [d]Cipriani et al., 2002

Table 3. Cases of genetically similar or close varieties found in the identification process between the FOGB and the WOGB based on 20 SSR loci.

	French variety (FOGB)	**Mediterranean variety (WOGB)**	**Number of dissimilar alleles**	**Origin**
1	[#]Boube	Gordale Sevillana[$]	2	Spain
		Santa Caterina	2	Italy
		Aguenaou	2	Algeria
2	[#]Cailletier	Arancino*	1	Italy
		Augellina*	1	Italy
		Correggiolo di pallesse*	1	Italy
		Frantoio*[$]	1	Italy
		Larcianese*	1	Italy
		Razzo*	1	Italy
		Puntino*	1	Italy
		San Lazzaro	2	Italy
		Baladi Ain	1	Lebanon
		Jlot	2	Lebanon
		Baladi Tawil*	1	Lebanon
		Fakhfoukha	2	Morocco
3	[#]Petit Ribier	Filare	2	Italy
		Moraiolo[$]	1	Italy
		Tondello	2	Italy
		Alethriko	2	Cypus
4	Cayon	Rougette de Mitidja	0	Algeria
5	Olivière	Kalokerida	0	Creece
6	Picholine	Abou Chawkeh	0	Lebanon
7	Reymet	Ciliegino*	1	Italy

		Rosino*	1	Italy
		Rossellino*	1	Italy
		Pesciatino*	1	Italy
8	#33-19	Leccino*$	2	Italy
		Gremignolo*	2	Italy

* Accessions showed similar in WOGB collection

French variety similar to foreign one and the reference variety

$the reference variety for the case of similarity between French and Foreign varieties

❖ Greece

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Hellenic Agricultural Organisation “DEMETER” is the national center for research, training and certification in agriculture and is supervised by the Ministry of Rural Development and Food. It comprises of four thematic General Directorates with about 750 employees and 11 research institutes. The Institute of Olive Tree, Subtropical Crops and Viticulture (IOSV) has laboratories and research fields in 6 areas of Greece covering many different olive production systems and soil and climate environments. Research focused on all aspects of olive tree growing and olive oil quality has been implemented for over 50 years. IOSV has expertise on several topics, including cultural practices related to olive growing (irrigation, fertilization, pruning, orchard management, etc.), physiological response of olive tree to abiotic and biotic factors, molecular and morphological characterization of olive cultivars.

The Institute for Olive Tree, Subtropical Crops and Viticulture in Chania, Greece, harbours the National Olive Germplasm Bank of Greece (NOGB) comprising over 100 cultivars from the main olive producing countries of the world. These cultivars are formally exchanged between the members of the Network of Olive Collections which is coordinated by the International Olive Oil Council (http://www.internationaloliveoil.org/). The NOGB is located at the Chrisopigi Monastery area near the Institute of Olive Tree, Subtropical Crops & Viticulture, Hellenic Agricultural Organization (H.A.O.) “Demeter” (Chania, Southern Greece). Mean air temperature in the area is 18 ºC, relative humidity (RH) 64 % and annual rainfall 600-800 mm (H.A.O. meteorological station, Chania, Greece).

Among them, over 45 cultivars originate from Greece and represent over 90 % of cultivated olive groves. The main aim of this collection is to preserve biodiversity, characterize agronomic behavior and ultimately utilize selected genotypes suitable for establishment in areas with unfavorable environmental conditions. A long-term research programme has been developed for this reason, starting from the RESGEN project in 1996 and continues up to date with various sources of funding.

The initial step in this long-term project was the morphological description of olive cultivars with features of the tree, leaves, flowers, fruit and seeds as described in Barranco et al. (2000a). Later on, molecular markers were widely employed for the genetic characterization of plants, and SSRs proved to be the most reliable markers in the case of olive (Belaj et al. 2018). A combination of morphological and genetic characterization of olive cultivars was also

employed to achieve higher accuracy (Koubouris et al., 2019). For genotyping, ten microsatellite loci were selected on the basis of their informativeness and previous experience in our group (DCA3, DCA5, DCA9, DCA14, DCA16, DCA18, Gapu101, UDO043, EM090, GAPU71B).

IOSV has installed a mother plantation with initial genetic material of the main Greek commercial varieties free of pathogens outlined in directives issued by the EU/EPPO. The collection aims to provide authenticated and healthy genetic material to the nurseries for propagation purposes. The collection is located in the central facilities of IOSV and comprises of 16 Greek (Valanolia, Koroneiki, Stroggylolia, Adramytini, Tsounati, Chondrolia Chalkidikis, Kalamon, Amfissis, Megareitiki, Gaidourelia, Koutsourelia, Lianolia Kerkyras, Throumpa, Lefkolia Serron, Makris, Asprolia Alexandroupolis) and 2 foreign cultivars (Picual, Arbequine). The field collection has been tested for the 4 viruses issued by the EU/EPPO in the past and is currently under new laboratory testing by the Plant Pathology Lab of IOSV.

In the future, characterization and utilization of plant genetic resources is expected to markedly benefit from the exploitation of new tools such as EST-SSRs (Mousavi et al., 2017), predictive machine learning algorithms (Beiki et al. 2012), deep sequencing of gene fragments (Cultrera et al. 2019) and whole genome sequencing (Cruz et al. 2016).

Some relevant publications are:

G. C. Koubouris, E. V. Avramidou, I. T. Metzidakis, V.P. Petrakis, C. K. Sergentani, A. G. Doulis. (2019) Phylogenetic and evolutionary applications of analyzing endocarp morphological characters by classification binary tree and leaves by SSR markers for the characterization of olive germplasm. Tree Genetics & Genomes. DOI: 10.1007/s11295-019-1322-0. https://link.springer.com/article/10.1007/s11295-019-1322-0

Koubouris, G., Bouranis, D., Vogiatzis, E., Nejad, A.R., Giday, H., Tsaniklidis, G., Ligoxigakis, E.K., Blazakis, K., Kalaitzis, P., Fanourakis, D. (2018) Leaf area estimation by considering leaf dimensions in olive tree. Scientia Horticulturae, 240, pp. 440-445. https://www.sciencedirect.com/science/article/pii/S0304423818304266

Aksehirli-Pakyurek, M., Koubouris, G. C., Petrakis, P. V., Hepaksoy, S., Metzidakis, I. T., Yalcinkaya, E., & Doulis, A. G. (2017). Cultivated and wild olives in Crete, Greece—Genetic diversity and relationships with major Turkish cultivars revealed by SSR markers. Plant Molecular Biology Reporter,35(6),pp.575-585.doi:10.1007/s11105-017-1046-y. https://link.springer.com/article/10.1007/s11105-017-1046-y

Xanthopoulou, A., Ganopoulos, I., Koubouris,G., Tsaftaris, A., Sergendani, C., Kalivas, A., Madesis, P. (2014) Microsatellite high-resolution melting (SSR-HRM) analysis for genotyping and molecular characterization of an Olea europaea germplasm collection. Plant Genetic Resources: Characterization and Utilization, 12, 273-277.https://www.cambridge.org/core/journals/plant-genetic-

resources/article/microsatellite-high-resolution-melting-ssr-hrm-analysis-for-genotyping-and-molecular-characterization-of-an-olea-europaea-germplasm-collection/BC0F6EB22D2282544F8C3BEAB47BE143

❖ Iran

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There are three olive germplasm banks in different regions of Iran as follow:

1- Minoodasht Olive Collection, Golestan Province,
2- Tarom Olive Collection, Zanjan Province
3- Aliabad Olive collection, Gilan Province

Names of olive collections	Minoodasht Olive Collection	Tarom Olive Collection	Aliabad Olive collection
Location	37°10'38.4"N 55°18'09.6"E Golestan Province	36°47'49.5"N 49°05'59.2"E Zanjan Province	36°45'11.8"N 49°16'59.6"E Gilan Province
Accessions (number, origin and denominations)	120 different varieties in triplet including: 10 main local cultivars 100 local genotypes 20 main Mediterranean cultivars	240 different varieties including: 10 main local cultivars 170 local genotypes 60 Mediterranean cultivars	52 different varieties including: 7 main local cultivars 45 Mediterranean cultivars
Morphological (UPOV-IOC descriptors) characterization	Almost all accessions have been characterized by UPOV-IOC descriptors	Almost all local cultivars and local genotypes have been characterized by	Local cultivars have been characterized by UPOV-IOC descriptors

		UPOV-IOC descriptors	
Molecular (particularly SSR) characterization	All varieties have been analyzed by 11 SSR markers	10 local cultivars have been analyzed by11 SSR markers	No molecular identification
Identification and authentication, homonyms, synonyms, incorrect denominations and molecular variants	Molecular identification is completed in this collection. Morphological characterization is in process. There are no homonyms, synonyms and incorrect denominations in this collection.	Morphological identification is completed in this collection. There are homonyms, synonyms and incorrect denominations in about 10 percent of this collection.	There are no homonyms, synonyms and incorrect denominations in this collection.
Diagnosis and health status of plants	In progress	Main local and Mediterranean cultivars are in health status (three main viruses and *verticillium* infection have been tested for these cultivars)	No diagnosis yet
Prospects	Identification of promising local varieties, breeding programs, Genotyping by Sequencing (GBS) analyses will be the priority programs in this collection.	Traditional breeding programs are in progress in this collection and new molecular method such as linkage analyses will help this program.	This collection will be a good candidate for providing true healthy olive plants in the future.
Names of main local cultivars	Zard, Rowghani, Mari, Shengeh, Fishomi, Dezful, Tokhm-Kabki, Dehghan,Shiraz, Gelooleh		

Significant publications, specifically addressed to characterization, cataloguing, identification and authentication of cultivars:

1. Hosseini Mazinani, Mehdi, Torkzaban, Bahareh, Arab, Jahangir. Iranian olive catalogue. Published by NIGEB (Persian/English), 2013,ISBN: 978-964-8516-23-4, pp212
2. Mousavi S., Mariotti R., Bagnoli F., Costantini L., Cultrera N.G.M., Arzani K., Pandolfi, S. Vendramin G.G., Torkzaban B., Hosseini-Mazinani M., Baldoni L., (2017). The eastern part of the Fertile Crescent concealed an unexpected route of olive (Olea europaea L.) differentiation. Annals of Botany DOI:10.1093/aob/mcx027
3. Bahareh Torkzaban, Amir Hossein, Kayvanjoo, Arman Ardalan, Soraya, Mousavi, Roberto Mariotti, Luciana Baldoni, Esmaeil Ebrahimie, Mansour Ebrahimi, Mehdi Hosseini-Mazinani (2015) Machine Learning Based Classification of Microsatellite Variation: An Effective Approach for Phylogeographic Characterization of Olive Populations. PLoS ONE 12/2015; 10(11). DOI:10.1371/journal.pone.0143465
4. Mehdi Hosseini-Mazinani, Roberto Mariotti, Bahareh Torkzaban, Massoma Sheikh-Hassani, Saeedeh Ataei, Nicolo G. M. Cultrera, Saverio Pandolfi, Luciana Baldoni, (2014) High Genetic Diversity Detected in Olives beyond the Boundaries of the Mediterranean Sea. PloS One. Vol.9 (4), e93146
5. Zahra Noormohammadia, Isabel Trujillob, Angjelina Belaj, Saeede Ataei, Mehdi Hosseini-Mazinand. (2014) Genetic structure of Iranian olive cultivars and their relationship with Mediterranean's cultivars revealed by SSR markers. Scientia Horticulturae, 178: 175-183.

❖ Israel

Giora Ben Ari

Location: **31°58'57.7"N 34°49'47.8"E**

Accessions:

#	Cultivar	Origin	Purpose (Oil, Table or Dual purpose)
1	Amigdalolia	Greece	D mainly T
2	Amigdalolia Nana	Greece	D
3	Arauco	Argentina	T
4	Arbequina	Spain	O
5	Arbosana	Spain	O
6	Ascolana	Italy	T
7	Askal	Israel	O
8	Azapa	Chile	T
9	Baladi	Lebanon	O
10	Barnea	Israel	O
11	Benjamina	Israel	O
12	Biancet	?	O
13	Biancolilla	Italy	O
14	Bosana	Italy	O
15	Broza	Israel	T
16	Cakir	Turkey	D
17	Canino	Italy	O
18	Carolea	Italy	T
19	Carrasquenha	Portugal	T
20	Chalkidiki	Greece	T
21	Changlot Real	Spain	O
22	Chemlali	Tunis	O
23	Comun de Sicilia	Ilaly	
24	Coratina	Italy	O
25	Cornezuelo	Spain	T
26	Cucco	Italy	T
27	Dan	Syria	T
28	Dolce Agogia	Italt	O
29	Domat	Turkey	T

#	Cultivar	Origin	Purpose (Oil, Table or Dual purpose)
30	Empeltre	Spain	O
31	Fadel	Israel	D
32	Farga	Spain	D mainly O
33	Frangivento	Italy	O
34	Frantoio	Italy	O
35	FRS-2	Australia	O
36	G. de Sardinia	Italy	T
37	G. de Sicily	Italy	T
38	Galega	Portugal	O
39	Gemlik	Turkey	D
40	Giarraffa	Italy	T
41	Ginati	Israel	D
42	Hebroni	Palestine	T
43	Hojiblanca	Spain	D mainly O
44	Imperial	Spain	O
45	Ispaniki	Spain	O
46	Jabaluna	Spain	O
47	Jericho	Palestine	T
48	Kadesh	Israel	T
49	Kadeshon	Israel	T
50	Kalamata (Kalamon)	Greece	D
51	Konservolia	Greece	T
52	Koroneiki	Greece	O
53	Leccino	Italy	O
54	Leccio	Italy	O
55	Lechin de sev.	Spain	O
56	Leuco Carpa	Italy	O
57	Lucques (Luke)	Ftence	D
58	Maalot	Israel	O
59	Manzanillo	Spain	D mainly T
60	Marfil	Spain	O
61	Masepo	Israel	T
62	Maurino	Italy	O
63	MCSSON 0517	?	
64	Memecik	Turkey	D

#	Cultivar	Origin	Purpose (Oil, Table or Dual purpose)
65	Merhavia	Israel	T
66	Mignolo	Italy	O
67	Mission New Norcia	?	O
68	Moraiolo	Italy	O
69	Moresca	Italy	D
70	Morrut	Spain	O
71	Muhasan	Palestine	D
72	Nabali	Palestine	D
73	Nasuchi	Palestine	T
74	Nevadillo blanco	Spain	D
75	Niedda de gonnos	Italy	D
76	Nocellara Etnea	Italy	D
77	Oblonga	USA	O
78	Olea Cuspidata		
79	Olea Oleaster	Italy	
80	ORS	Australia	O
81	Paragon	Australia	O
82	Pendolino	Italy	O
83	Picholine Languedoc	France	D
84	Picholine Marocaine	Marocco	D
85	Picual	Spain	O
86	Picual III	Spain	O
87	Picudo	Spain	O
88	Pizz'e Carroga	Italy	O
89	Rama Pendula	Italy	O
90	Round Greek	Greece	T
91	Rowi	?	
92	Rubra	?	O
93	Saiali Magloub	Tunis	
94	San Francisco	Italy	O
95	Sant' Agostino	Italy	T
96	Santa Caterina	Italy	T
97	Sepoka	Israel	T
98	Sevillano Aust	Spain	T
99	Shami	Syria	T

#	Cultivar	Origin	Purpose (Oil, Table or Dual purpose)
100	Sigoise	Algeria	D
101	Sorani	Syria	D
102	Souri	Lebanon Israel	D
103	Taggiasca	Italy	O
104	Tamir	Israel	O
105	Tanche	France	D
106	Tell	Algeria	D
107	Tlemcen	Algeria	D
108	Toffahi	Egypt	T
109	Tonda calliari	Italy	D
110	Tonda oliana	Italy	D
111	UC13A6	USA	T
112	Uovo di Piccione	Italy	T
113	Uslu	Turky	D
114	Vasilikada	Greece	
115	Verdial	Spain	O
116	Verdial De Jaen	Spain	O
117	Zarza	Spain	
118	Zarzamora	?	
119	Zorzariega	Spain	D

- Morphological (UPOV-IOC descriptors) characterization:

See publication. In addition: fruit size and oil content:

Cultivar	fresh wt.	stone wt.	% ston	% dry	Comm Oil	% oil dry
Amigdalolia	6.82	1.04	15.24	49.00	23.90	57.55
Arbequina	0.82	0.30	36.41	55.40	15.90	45.13
Ascolana	8.59	1.06	12.34	38.00	16.65	50.00
Ascolana – 88	7.32	0.86	11.74	42.00	24.71	66.67
Ayvalik	4.40	0.80	18.18	51.80	18.00	42.47
Azapa	6.83	0.69	10.10	46.00	20.68	50.00
Baladi	2.64	0.66	25.00	64.40	18.45	38.20
Barnea	1.98	0.49	24.75	44.00	33.41	100.91
Benjamina	2.01	0.43	21.37	50.20	15.25	38.65

Cultivar	fresh wt.	stone wt.	% ston	% dry	Comm Oil	% oil dry
Bosana	2.59	0.62	23.91	52.00	22.98	58.08
Broza	4.35	1.26	28.98	44.40	17.19	54.50
Cakir	3.44	0.71	20.66	57.60	19.04	41.67
Canino	0.91	0.32	35.09	58.80	16.49	43.20
Carolea	5.95	0.92	15.47	46.00	22.49	57.83
Carrasquenha	2.60	0.68	26.15	54.40	25.26	62.87
Conservolia	6.22	0.62	9.96	42.00	23.95	63.33
Coratina	2.59	0.56	21.64	45.80	18.65	51.97
Cornezuelo	6.58	0.73	11.09	40.00	23.29	65.50
Cucco	6.23	0.94	15.09	45.20	22.76	59.29
Dolce Agogia	1.23	0.26	21.17	42.80	19.08	56.54
Dolce de Marocain	2.02	0.70	34.58	60.80	18.05	45.39
Domat	3.70	0.90	24.38	56.00	20.72	48.93
Empeltre	3.55	0.54	15.20	40.40	26.29	76.73
Farga	2.18	0.39	17.89	35.20	18.23	63.07
Frangivento	2.68	0.41	15.45	52.00	22.49	51.15
Frantoio	2.86	0.59	20.60	49.00	21.28	54.69
Galega	1.34	0.40	29.76	51.20	13.77	38.28
Gemlik	2.50	0.65	26.03	61.20	31.51	69.61
Giarraffa	10.59	1.08	10.20	39.20	23.17	65.82
Hebroni	6.61	0.84	12.70	42.20	27.24	73.93
Hojiblanca	5.70	0.76	13.34	35.20	20.80	68.18
Ispaniki	2.84	0.65	23.06	44.00	15.23	45.00
Jabaluna	7.91	1.08	13.65	45.60	16.75	42.54
Jericho	2.85	0.58	20.37	52.00	21.98	53.08
Kadeshon	10.91	1.20	11.04	27.80	13.70	55.40
Kalamata	3.82	0.60	15.72	43.00	21.91	60.47
Koroneiki	0.67	0.21	31.55	42.00	17.52	60.95
Leccino	2.04	0.57	27.79	44.80	14.01	43.30
Leccio	2.48	0.57	22.82	47.80	20.07	54.39
Lechin de sev.	2.28	0.41	18.01	42.20	20.66	59.72
Maalot	2.34	0.68	29.11	56.00	18.86	47.50
Manzanillo	2.44	0.56	22.91	48.00	19.43	52.50
Marfil	2.18	0.50	22.94	36.40	18.65	66.48
MCSSON 0517	3.14	0.61	19.43	35.40	22.72	79.66

Cultivar	fresh wt.	stone wt.	% ston	% dry	Comm Oil	% oil dry
Memecik	3.18	0.72	22.64	51.60	21.51	53.88
Merhavia	5.29	0.68	12.85	39.20	18.65	54.59
Mission New Norcia	1.84	0.58	31.52	53.40	20.54	56.18
Moraiolo	2.80	0.49	17.53	52.60	19.46	44.87
Moresca	6.68	0.70	10.49	46.40	30.79	74.14
Morrut	2.97	0.76	25.55	47.00	18.16	51.91
Muhasan	2.65	0.56	21.12	58.00	26.50	57.93
Nabali	4.11	0.56	13.53	50.40	26.80	61.51
Niedda de gonnos	4.08	0.82	20.12	48.60	22.05	56.79
Niedda de oliana	2.42	0.74	30.58	62.40	19.99	46.15
Nocellara Etnea	3.22	0.76	23.57	50.00	16.97	44.40
Oblonga	1.93	0.72	37.27	62.60	21.33	54.31
Olea Oleaster	0.68	0.29	42.06	30.60	14.02	79.08
ORS	4.00	0.62	15.40	28.60	21.15	87.41
Paragon	2.93	0.55	18.83	47.40	17.37	45.15
Pendolino	2.36	0.58	24.58	46.40	18.86	53.88
Picholine Languedoc	4.92	0.54	10.98	47.00	17.45	41.70
Picholine Marocaine	5.06	0.52	10.28	45.20	27.45	67.70
Picual	3.30	0.76	23.03	38.00	20.47	70.00
Picual III	4.07	0.85	20.89	33.60	16.61	62.50
Picudo	3.74	0.99	26.44	39.40	15.15	52.28
Pizz'e Carroga	4.92	0.76	15.38	33.80	13.88	48.52
Round Greek	5.08	0.72	14.18	54.40	26.09	55.88
Rowi	3.82	0.70	18.31	34.00	19.77	71.18
Rubra	2.74	0.50	18.22	42.60	18.48	53.05
San Francisco	4.55	0.71	15.60	32.60	14.69	53.37
Sant' Agostino	2.79	0.42	15.06	50.00	18.69	44.00
Sepoka	4.66	0.72	15.46	43.00	20.29	55.81
Sevillano Aust	15.11	1.44	9.53	29.60	15.92	59.46
Sigoise	5.36	0.73	13.63	37.00	17.97	56.22
Sorani	3.28	0.50	15.23	40.00	16.95	50.00
Souri	3.42	0.54	15.81	54.00	21.55	47.41
Taggiasca	2.72	0.68	25.00	62.00	18.15	39.03
Tanche	4.03	0.75	18.72	46.00	19.02	50.87
Tell	4.83	0.72	14.91	39.20	22.97	68.88

Cultivar	fresh wt.	stone wt.	% ston	% dry	Comm Oil	% oil dry
Tlemcen	3.48	0.60	17.22	35.60	-1.49	-5.06
UC13A6	14.10	0.83	5.89	29.00	23.72	86.90
Uovo di Piccione	8.66	0.99	11.44	33.40	16.83	56.89
Uslu	2.58	0.49	19.02	34.00	18.30	66.47
Vasilikada	3.49	0.78	22.34	50.00	18.79	48.40
Verdial	3.65	0.67	18.37	42.20	15.51	45.02
Verdial De Jaen	5.54	0.64	11.55	43.20	25.47	66.67
Zorzariega	6.73	0.86	12.77	41.20	21.46	59.71

- Molecular (particularly SSR) characterization138 SNPs for all of them.16 SSRs for some of them.
  - ✓ Identification and authentication, homonyms, synonyms, incorrect denominations and molecular variants
- Diagnosis and health status of plants

  Didn't test.

  - ✓ Prospects
- Significant publications, specifically addressed to characterization, cataloguing, identification and authentication of cultivars(No more than 5)

Iris Biton, Sofia Shevtsov, Oren Ostersetzer, Yair Mani, Shimon Lavee, Benjamin Avidan and **GioraBen-Ari** (2012). Assessment of the genetic structure and hybrid-vigor in olive (Olea europaea L.) by microsatellites.*Plant breeding*. 131: 767-774.

Iris Biton, Adi Doron-Faigenboim, Mahital Jamwal, Yair Mani, Ravit Eshed, Ada Rosen, Amir Sherman, Ron Ophir, Shimon Lavee, Benjamin Avidan and **Giora Ben-Ari** (2014). Development of alarge set of SNP markers for assessing phylogenetic relationships among the olive cultivars composingthe Israeli olive germplasm collection.*Molecular Breeding* 35: 107.

❖ Italy

Enzo Perri

Location: CREA–Research Centre for Olive, Citrus and Tree Fruit - World Olive Germplasm Collection, Mirto Crosia (CS), Italy (39º 36’ 18” N, 16º 44’ 37” E).

Curator: Dr Enzo Perri, Research Director and Responsible of the Rende section of CREA OFA

CREA–Research Centre for Olive, Citrus and Tree Fruit, C.da Li Rocchi, 87036 Rende (CS), Italy

The World Olive Germplasm Collection of Council for Agricultural Research and Economics (CREA)–Research Centre for Olive, Citrus and Tree Fruit (OFA), C.da Li Rocchi, 87036 Rende (CS), Italy (WOGC-CREA OFA), represented one of the most important international olive germplasm collection and, till now, the largest olive *ex situ* collection, as stated by the “The second report on the state of the world’s plant genetic resources for food and agriculture”, edited by the Commission on genetic resources for food and agriculture, Food and Agriculture Organization of the United Nations, of 2010 (http://www.fao.org/3/i1500e/i1500e00.htm), comprising at least the 17 % of the total world accessions. This germplasm collection was established in the 1980s as systematic collection of Italian olive varieties for deposit into specific catalogue fields as required by a particular regulation of the Italian Ministry for Agriculture and Forestry. The initial purpose of the collection was to carry out a survey on the national olive varieties, characterize them by morphological traits and introduce them into the genetic bank. Material identified by other international scientific institutions (International Treaty on Plant Genetic Resources for Food and Agriculture - Plant Genetic Resources RGV-FAO Projects) was also included. The first collection field was built in Mirto Crosia (CS), by the Experimental Institute for Olive Growing, which at that time belonged directly to the Italian Ministry for Agriculture and Forestry, at the local Experimental Demonstrational Centre of the Regional Agency for Agricultural Services and Development of Calabria Region (ARSSA), thanks to a particular agreement. During all these years, mainly thanks to the “International Treaty on Plant Genetic Resources for Food and Agriculture” funding, through the Italian Ministry for Agriculture and Forestry, the CRA Research Centre for olive growing, first, the Research Center for Olive growing and olive Oil Industry, second, and finally, the more recent CREA - Research Centre for Olive, Citrus and Tree Fruit, they all supported the maintenance and increase of this germplasm collection.

Actually, the World Olive Germplasm Bank of CREA OFA includes: the WOGC-Mirto Crosia field collection, and its *in progress* backup at Li Rocchi campus, Rende, near the CREA–Research Centre for Olive, Citrus and Tree Fruit building (Li Rocchi olive field A, B and C). In addition, it comprise also the Spoleto field collection with 316 olive different accessions.

The WOGC-CREA OFA collection represent the national olive germplasm collection of reference (ITA-401). CREA OFA is the Institution officially in charge of the conservation of olive genetic resources at national (Italian) level, though close to the olive collections belonging to the Research National Council.

From its initials, more than 30 years ago, the WOGC-CREA OFA collection has been feeded by olive cultivars collected from Italy and other countries as well as accessions provided by the Italina Ministry of Agriculture, Food and Forestry Policy, and different Scientific Institutions and nursery.

Nowadays, the Mirto Crosia WOGC collection accounts around 562 italian accessions e 54 foreingh accessions, from 11 different countries.

The WOGC-CREA OFA collection has systematically been studied by several Italian research teams but mainly by the CREA OFA team who has also been in charge for its agronomic, elaiochemical and elaiographyc evaluation (Perri *et al.,* 2016), apart from its responsibility for conservation and management of the field collections. In particular, the CREA OFA teams are leading the characterisation and identification of olive cultivars (Perri *et al,* 2018; Muzzalupo 2016; Muzzalupo *et al.,* 2018) as well as phenology (Bruno *et al.,* 2009; Sabetta *et al.,* 2013) and disease and pest resistance studies (Bruno *et al.,* 2009). Although different morphological (Padula *et al.,* 2008), biochemical (Perri *et al,* 1995) and molecular descriptors have been used in this collection (Muzzalupo *et al.,* 2007; 2008a and 2008b; 2009: Taranto *et al.,* 2018a and 2018b), the SSRs have played an important role for its identification (Baldoni, *et al*., 2009).

The plant material maintained at the WOGC-CREA OFA collection and its study have contributed to the generation of important knowledge and publications in olive characterization such as:

Perri Enzo, Zelasco Samanta, Benincasa Cinzia, Vizzarri Veronica, Carbone Fabrizio, Lo Feudo Gabriella, Alessandrino Sabina, Salimonti Amelia, Romano Elvira, Pellegrino Massimiliano, Godino Gianluca, Zaffina Francesco, Parise Attilio, 2016, Il germoplasma olivicolo del campo collezione del Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria - Centro di ricerca per l'olivicoltura e l'industria olearia di Rende, edito dal Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria - Centro di ricerca per l'olivicoltura e l'industria olearia di Rende (CREA-OLI), ISBN 978-88-99595-04-3.

(http://sito.entecra.it/portale/public/documenti/germoplasma_olivicolo.pdf?lingua=IT).

Muzzalupo I., Olive Germplasm - Italian Catalogue of Olive Varieties (Muzzalupo I. Ed.), InTech Open Science/ Open Mind (2012)

(https://www.intechopen.com/books/olive-germplasm-italian-catalogue-of-olive-varieties/olive-germplasm-italian-catalogue-of-olive-varieties).

Other publications relating the WOGC of CREA OFA are indicated below:

Baldoni L., Nicolo` G. Cultrera, Roberto Mariotti, Claudia Ricciolini, Sergio Arcioni, Giovanni G. Vendramin, Anna Buonamici, Andrea Porceddu, Vania Sarri, Maria A. Ojeda, Isabel Trujillo, Luis Rallo, Angjelina Belaj, **Enzo Perri,** Amelia Salimonti, Innocenzo Muzzalupo, Alberto Casagrande, Orietta Lain, Rachele Messina, Raffaele Testolin, 2009, A consensus list of microsatellite markers for olive genotyping, Mol. Breeding, 24: 213-231, DOI 10.1007/s11032-009-9285-8.

Benincasa C., Elvira Romano, Massimiliano Pellegrino and **Enzo Perri,** 2018, Characterization of Phenolic Profiles of Italian Single Cultivar Olive Leaves (*Olea europaea* L.) by Mass Spectrometry, Mass Spectrom. Purif. Tech., 2018, 4:1, DOI: 10.4172/2469-9861.1000124.

Bruno L., Chiappetta A., Muzzalupo I., Gagliardi C., Iaria D., Bruno A., Greco M., Giannino D., **Perri E.**, Bitonti M.B., 2009, Role of geranylgeranyl reductase gene in organ development and stress response in olive (*Olea europaea*) plants, Functional Plant Biology, 36:370–381

Food and Agriculture Organization of the United Nations, 2010, The second report on the state of the world's plant genetic resources for food and agriculture", edited by the Commission on genetic resources for food and agriculture, ISBN 978-92-5-106534-1, Rome, 2010 (http://www.fao.org/3/i1500e/i1500e00.htm).

Muzzalupo I., Nicola Lombardo, Aldo Musacchio, Maria Elena Noce, Giuseppe Pellegrino, **Enzo Perri**, and Ashif Sajjad, 2006, DNA Sequence Analysis of Microsatellite Markers Enhances Their Efficiency for Germplasm Management in an Italian Olive Collection, J. Amer. Soc. Hort. Sci., 131(3):352-359.

Muzzalupo, I., A. Fodale, N. Lombardo, R. Mulè, M.A. Caravita, A. Salimonti, M. Pellegrino and **Perri E.,** 2007. Genetic diversity and relationships in olive Sicilian germplasm collections as determined by RAPD markers. Ad. Hort. Sci. 21:35-40.

Muzzalupo I., Lombardo N., Salimonti A., Caravita M.A., Pellegrino M., **Perri E.**, Molecular characterization of Italian olive cultivars by microsatellite markers, Advances in Horticultural Science, 2008a, 22 (2): 142-148.

Muzzalupo I., **Perri E.,** Genetic characterization of olive germplasms by molecular markers, The European Journal of Plant Science and Biotechnology, 2008b, 2(1):60-68.

Muzzalupo I., Salimonti A., Stefanizzi F., Falabella R., **Perri E.** Microsatellite markers for identification of intra-cultivar variabilità within olive (Olea europaea L.) trees, 2009, Scientia Agricola, v.66, n.5, p. 685-690.

Muzzalupo I., Lombardo N., Salimonti A., Pellegrino M., Caravita M.A., **Perri E**., SSR markers for characterization and identification of cultivars of Olea europaea L. in the Abruzzo and Molise regions in south-central Italy, Advances in Horticultural Science, 2008, 22 (2):129-135.

Muzzalupo I., Basti C., Rosati A., Perri E., 2013, La collezione del germoplasma olivicolo del CRA-OLI, in Conservazione biodiversità, gestione banche dati e miglioramento genetico – BIODATI, Vol. 1, Edizioni Nuova Cultura – Roma, ISBN 9788868120986, pp. 205-242.

Muzzalupo, I.; Perri, E.; Chiappetta, A.- Fruit Germplasm Characterization: Genomics Approaches for the Valorisation of Genetic Diversity, Genetic diversity in plants, Chapter 4, pp. 55-86, Intech Open Science Open Minds ISBN 978-953-51-0185-7, anno 2012.

Padula G., Giordani E., Bellini, Rosati A., Pandolfi S., Paoletti A., Pannelli G., Ripa V., De Rose F., **Perri E.,** Buccoliero A., Mennone C. 2008. Field evaluation of new olive (*Olea europaea* L.) selections and effect of genotype and environment on productivity and fruit characteristics, Adv. Hort. Sci., 22(2):87-94.

Perri E., Parlati M.V., Palopoli A., Rizzuti B., 1995, Polimorfismo isoenzimatico del polline dell'olivo (Olea europaea L.), Italus Hortus, 2(1-2):31-36.

Ripa V., De Rose F., Caravita M.A., Parise M.R., **Perri E.,** Rosati A., Pandolfi S., Paoletti A., Pannelli G., Padula G., Giordani E., Bellini E., Buccoliero A., Mennone C., 2008. Qualitative evaluation of olive oils from new olive selections and effects of genotype and environment on oil quality. Adv. Hort. Sci., 22(2): 95-103.

Sabetta W., Antonio Blanco, Samanta Zelasco, Luca Lombardo, **Enzo Perri,** Giacomo Mangini, Cinzia Montemurro, 2013, Fad7 gene identification and fatty acids phenotypic variation in an olive collection by ecotilling and sequencing approaches, Plant Physiology and Biochemistry 69, 1-8.

Taranto F., D'Agostino N., Pavan S., Fanelli V., Di Rienzo V., Sabetta W., Miazzi M.M., Zelasco S., **Perri E.,** Montemurro C., 2018a, GBS-derived SNP catalogue unveiled wide genetic variability and geographical origin of Italian olive cultivars. Sci. Rep. 8:15877; DOI 10.1038/s41598-018-34207y.

Taranto F, D'Agostino N, Fanelli V, di Rienzo V, Miazzi MM, Pavan S, Zelasco S, **Perri E**., Montemurro C. 2018b. Single nucleotide polymorphism (SNP) diversity in an olive germplasm collection. Acta Horticulturae 1199:27–32 DOI 10.17660/ActaHortic.2018.1199.5.

Figure 1. Geographic localization and absolute cordinates of the CREA–Research Centre for Olive, Citrus and Tree Fruit - World Olive Germplasm Collection, Mirto Crosia (CS), Italy.

Table 1. The original FAO table of the largest *ex situ* collections of selected crops from the "The second report on the state of the world's plant genetic resources for food and agriculture (FAO, 2010).

TABLE 3.2 (continued)
Holders of the six largest *ex situ* collections of selected crops

Genus (crop)	Total world accessions	Major holders rank			
		1	%	2	%
Manihot (cassava)	32 442	CIAT	17	CNPMF (BRA004)	9
Dactylis (grasses)	31 394	BYDG (POL022)	19	NIAS (JPN019)	9
Coffea (coffee)	30 307	IRCC/Cirad (CIV011)	22	IAC (BRA006)	14
Mangifera (mango)	25 659	Ayr DPI (AUS088)	73	CISH (IND045)	3
Beta (sugarbeet)	22 346	W6 (USA022)	11	IPK (DEU146)	10
Elaeis (oil-palm)	21 103	INERA (COD003)	84	MPOB (MYS104)	7
Panicum (millet)	17 633	NIAS (JPN003)	33	KARI-NGBK (KEN015)	13
Chenopodium (chenopodium)	16 263	BNGGA-PROINPA (BOL138)	27	INIA-EEA.ILL (PER014)	9
Dioscorea (yam)	15 903	IITA	21	UNCI (CIV006)	10
Musa (banana)	13 486	INIBAP	9	Cirad (FRA014)	4
Theobroma (cocoa)	12 373	ICGT	19	CRIG (GHA005)	8
Eragrostis (millet)	8 820	IBC (ETH085)	54	W6 (USA022)	15
Colocasia (taro)	7 302	WLMP (PNG006)	12	RGC (FJI049)	12
Psophocarpus (bean)	4 217	DOA (PNG005)	11	DGCB-UM (MYS009)	10
Corylus (nut)	2 998	COR (USA026)	28	AARI (TUR001)	14
Olea (olive)	2 629	CRA-OLI (ITA401)	17	CIFACOR (ESP046)	12
Bactris (peach palm)	2 593	UCR-BIO (CRI016)	31	CATIE	24
Pistacia (pistachio)	1 168	NPGBI-SPII (IRN029)	29	DAV (USA028)	26

Table 2. Molecular characterization and authentication of olive varieties in collection: the 8 microsatellite markers (SSR) used.

DCA3	DCA5	DCA8	DCA9
DCA16	DCA18	EMO090	GAPU71b

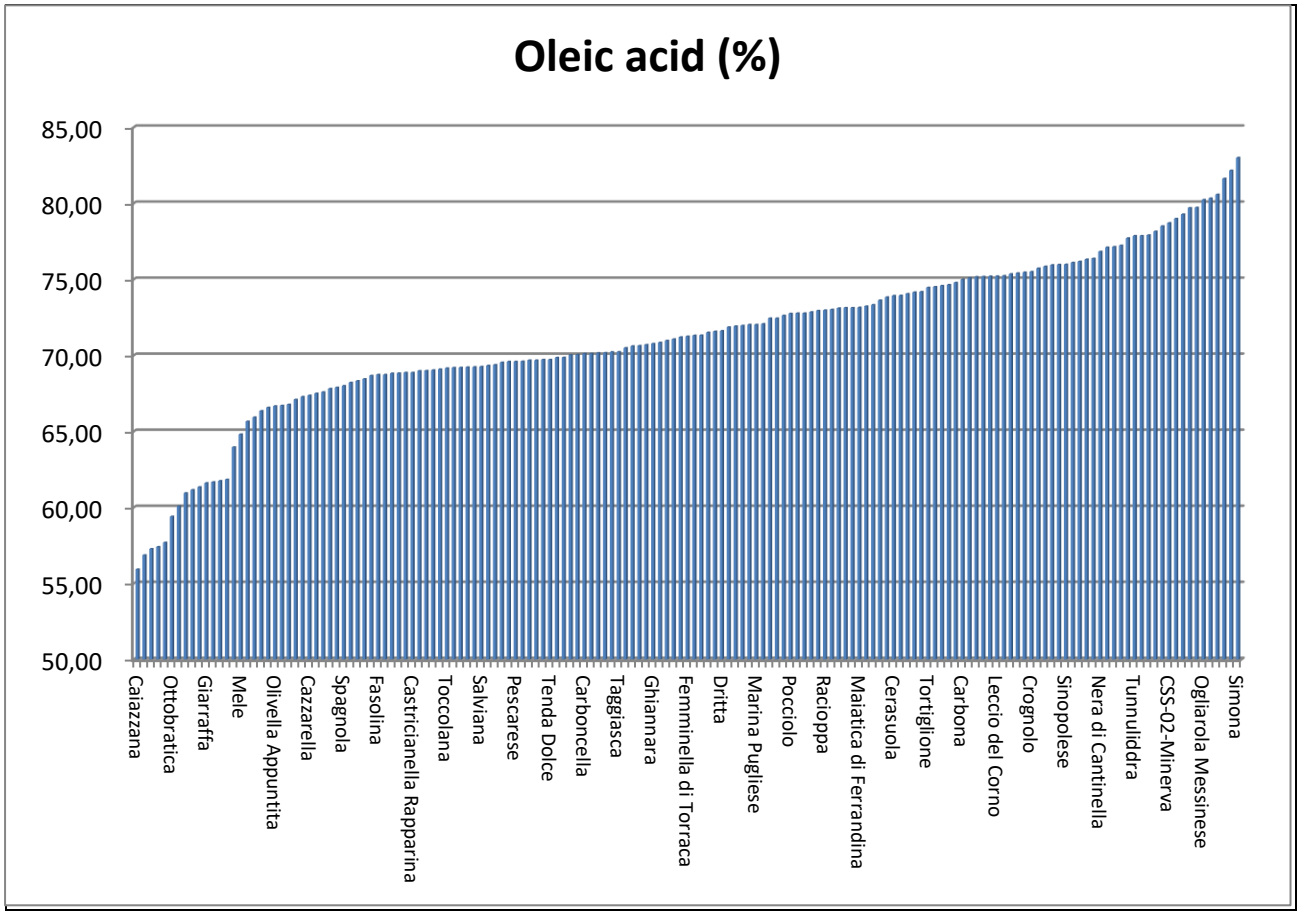

Figure 2. The percentage of oleic acid variability among varieties in the WOGC-CREA OFA collection.

❖ Jordan

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NARC is the only governmental agricultural research institution at the national level and is the national umbrella for the applied scientific research and agricultural consultation. It is the scientific arm of the Ministry of Agriculture that is entrusted with the responsibility of conducting applied scientific research and providing agricultural consultations.

NARC has the olive germplasm bank which was established in 1996 at Al Mushaqar Research Station located 28 Km to the South West of Amman. Altitude: 790 m above sea level with Longitude: 35º 47` East, Latitude: 31º 46` North , Area of the collection: 2.5 ha, Average rainfall: 360 mm , Average lowest temperature: 10.2 ºC, Average highest temperature: 22.9 ºC, Relative humidity: 40%-70%, Soil type: Clay loam, Soil pH: 7.8-7.9 and Soil electrical conductivity: 0.5 mmohs/cm.

The national collection consists of 47 olive cultivars, including 34 foreign cultivars and 13 autochthonous which are *Nabali Baladi, Rasei*, *Nabali Muhasan, Nasouhi Jaba , Souri, Shami, Kfari Romi, Kfari Baladi, Kanabisi, Arabi Altafila, Ketat, Bathni, Rosai.*

Trees were planted in rows of 10 trees of each cultivar. Tree spacing was at 6 meters within rows and 7 meters between rows. The olive trees are trained with minimum pruning and grown under rain-fed conditions and standard cultural practices. These cultivars are grown in different areas of Jordan.

Primary characterization of the Jordanian olive cultivars was completed for the 13 olive cultivars held in the national collection. Data were entered in the RESGEN project database. Morphological characterization was performed according to the “methodology for the primary characterization of olive varieties adapted by the International Olive Council (IOC). The following quantitative or qualitative descriptors were carried out. Fifteen of the characters (marked by an asterisk) are considered very heritable. Characters of the tree, Characters of the Leaf, Characters of the inflorescence, Characters of the fruit, Characters of the endocarp (stone), Secondary characterization of cultivars such as: Rooting ability, Pomological characterization, Oil determination, Fatty acids composition, Total polyphenols determination.

Also the 13 autochthonous cultivars mentioned above, were characterized using random amplified polymorphic DNA (RAPD) and inter-simple sequence repeats (ISSRs) markers. Using 15 RAPD and 14 ISSR primers, 156 and 85 reproducible markers were obtained, respectively. The percentage of polymorphism was 55 for RAPD and 58 for ISSR. Of the total polymorphisms identified, eight RAPD and three ISSR markers were cultivar-specific. Thirty-nine RAPD markers were able to distinguish 10 cultivars and 12 ISSR markers were able to distinguish 6 cultivars. Both markers (RAPD and ISSRs) were able to discriminate between all cultivars.

Puplications:

Ayoub, S. Shdiefat, S., Ahmad, R., and Al-Hewian, M. 2009. Morphological and pomological characteristics of Jordanian olive cultivars.Proceeding of the Third International Seminar on OliveBioteq. Sfax, Tunis.

Brake M, Migdadi H, Al-Gharaibeh M, Ayoub S, Haddad N, et al. (2014) Characterization of Jordanian olive cultivars (Olea europaea L.) using RAPD and ISSR molecular markers. Scientia Horticulturae 176: 282-289.

❖ Liban

Milad El Riachy

Table 1: List of 49 local accessions representing most of the Lebanese olive germplasm

N	Accession	Clone	Origin	year of plantation	Number of trees
1	B1	Baladi	Hermel		-
2	B2	Baladi	Hermel		-
3	B3	Bou Chawkeh	Fakehe	2009	3
4	B6	Baladi	Fakehe	2009	2
5	B7	Baladi	Aain	2009	3
6	B8	Baladi	Aain	2009	4
7	B9	Baladi	Deir Jabbouleh	2009	4
8	B10	Balah	Labweh		-
9	B11	Kalb-el-tair	Labweh	2018	4
10	B13	Teliani	Niha	2009	4
11	B14	Baladi	Bednayel	2009	2
12	B15	Baladi	El-Nabichite	2009	2
13	B16	Baladi	Nabichite		-
14	B19	Jlot	Lala	2018	4
15	B21	Del	Bakkifa	2018	4
16	T1	Baladi	Ain Baal		-
17	T2	Souri	Ain Baal	2009	2
18	T3	Baladi	Hanawav	2009	2
19	T5	Baladi	Oana	2009	4
20	T6	Baladi	Oana	2018	3
21	T7	Baladi	Remadieh	2018	3
22	T8	Baladi	Remadieh	2018	3
23	T9	Baladi	Oana	2018	4
24	T11	Baladi	Oana	2018	3
25	T14	Baladi	Oana	2009	3
26	T15	Baladi	Janata	2018	4
27	T19	Baladi	Deir Aamass	2018	4
28	T21	Baladi	Deir Aamess	2009	4
29	T22	Baladi	Aitaroun	2009	3
30	T23	Baladi	Sheheen	2018	4
31	T24	Baladi	Aitaroun	2009	2
32	T25	Souri	Tyr	2009	1
33	T26	Baladi	Deir Memass		-
34	T28	Baladi	Deir Memass		-
35	K2	Remmani	Amioun	2009	2
36	K5	Baladi	Iid Ibrine		-
37	K7	Baladi	Iid Ibrine	2009	3
38	K8	Chami	Kfaraaka		-
39	K10	Baladi	Bechmizine		-
40	K12	Remmani	Aaba		-
41	K13	Baladi	Kfarma		-
42	K17	Baladi	Kfarzaina	2018	3
43	K19	Baladi	Zgharta		-
44	Aavrouni	Aavrouni	Amioun	2018	4
45	L1	Baladi	Hasrout		-

N	Accession	Clone	Origin	year of plantation	Number of trees
46	L2	Sabbighi	Hasrout	2018	4
47	L3	Baladi	Hasrout		-
48	L4	Ayrouni	Dahr el Wahech		-
49	L9	Masri	Bouriein		-

❖ **Libya**

Daghees Abdelhakem

❖ Montenegro

Biljana Lazovic

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Biotechnical Faculty is the focal point for plant genetic resources in Montenegro, appointed from the Ministry of Agriculture and Rural Development. For the subtropical cultures and olive genetic resources responsible is the Centre for Subtropical Cultures, which traditionally (more than 80 years) work on research of different aspects of olive production. In the Center there is a laboratory equipped for chemical analyses (UV, GC, HPLC), and panel.

During the activity of RESGEN and SEEDnet projects the main activities on inventory, collection and characterization of olive genetic resources were performed. One of the aims of these activities was to propagate and save the plant material of the local varieties. Due to the lack of land, plant material propagated in the nursery of the Centre for Subtropical Cultures in Bar during 1997-2004, was transferred in pots and saved in the Center. For majority of twelve genotypes (Fran, Oleaster, Lumbardina, Zutica, Crnica, Drobnica, Zinzulaca, Sarulja, Sitnica, Barkinja, Gloginja, Lopusica), three copies were saved. This collection serves as a safe collection. Beside olive varieties four clones of Crnica variety represented with three plants were also saved. In the Center there is also a field collection of 14 foreign varieties, presented with 1-5 trees.

As a result of work on genetic resources and collaboration with Olive Growers Association 'Boka' the first olive collection of local varieties was established in 2011. The land for collection was obtained from the Monastery 'Podlastva' and is located in its vicinity. The olive collection is formed on terraces and is composed of 11 Montenegrin olive varieties (Fran, Lumbardina, Crnica, Drobnica, Sarulja, Sitnica, Lumbardeska, Barkinja, Gloginja, Lopusica, Zutica) represented with 3 to 5 trees. Beside the local genotypes, in the collection are planted 7 clones of main variety Zutica, one clone of Crnica, and foreign variety Leccino.

There is also area in the private land (with contract) planted in 2013 with 18 clones of Zutica variety.

For the 13 local olive varieties morphological characterization of tree, leaves, inflorescence, fruit and endocarp, was performed according to descriptors (Baranco et al. 2000).

Beside the morphological parameters, there were also analyzes on molecular level, with RAPD and SSR markers. A set of nine SSR markers (DCA3, DCA9, DCA11, DCA14, DCA16,

EMO90, GAPU101, UDO99-19) was used for genotyping 12 local varieties. Molecular variants were obtained among three varieties, Zutica, Crnica and Sitnica that need further research and comparison. The collection 'Podlastva' was not checked with molecular markers.

Synonyms are recorded in case of Crnica (Crnjaka) and Zutica (Bjelica).

Montenegrin varieties were not tested on viruses. Previous analyses showed their medium sensitivity to picklock eye and high to olive fly.

Since Biotechnical Faculty in last 14 years dominantly occupied with education/teaching, as well as researchers in the olive sector, questionable is the existence of the collections. However, future prospective would be to extend the work on characterization of the olive material (varieties, clones, old olives, oleasters and unknown genotypes) on morphological and molecular level, to improve nursery conditions for olive propagation as precondition for utilization of local olive germplasm, as well as the lab conditions (also human resources) to analyze specificity of each variety fruit and olive oil.

Some relevant publications are:

1. Lazović B., Klepo T., Adakalić M., Šatović Z., Baruca Arbeiter A.,Hladnik M., Strikić F., Liber Z., BandeljD. (2018) Intra-varietal variability and genetic relationships among the homonymic East Adriatic olive (*Olea europaea* L.) varieties.Scientia Horticulturae, 236; 175–185. https://doi.org/10.1016/j.scienta.2018.02.053

2. Lazović B., Adakalić M., Pucci C., Perović T., Bandelj D., Belaj A., Mariotti R., Baldoni L. (2016) Characterizing ancient and local olive germplasm from Montenegro. Scientia Horticulturae, 209 (2016) 117–123 http://dx.doi.org/10.1016/j.scienta.2016.06.022

3. LazovicB.,AdakalicM. and Perovic T. (2014) Clonal variability of Montenegrin olive variety 'Zutica'. 7th International Symposium on Olive Growing, San Juan, Agrentina. Acta Hort. (ISHS) 1057:501-507, http://www.actahort.org/books/1057/1057_63.htm

Lazović B., Adakalić M. (2012) 'Following Olive Footprints in Montenegro'In:**Mohamed EL-Kholy, et al.** 'Following Olive Footprints (*Olea europaea* L.), Cultivation and Culture, Folklore and History, Traditions and Uses'. *Scripta Horticulturae* N. 13 series ISHS, ISSN 1813-9205, 254-266.www.ishs.org, www.aarinena.org, www.internationaloliveoil.com

❖ Morocco

El Hassane Sikkaoui (INRA)

The olive groves are a part of global biodiversity occupying the wider Mediterranean region for thousands years. It plays in this region a significant socio-economic and ecological role.
For its extensive geographical area, its ancient cultivation, the cultivation of the olive tree has accumulated a large genetic variability that is an asset to significant potential for exploitation. This plant material was exposed and still more to genetic erosion favored by the abandonment of old varieties that no longer meet the socio-economic demands and the increasing modernization of the olive sector. However, this erosion can inevitably lead to loss of valuable genes for ever. Considering the importance of these resources, the International Olive Oil Council decided in 1995 with the support of Genetic Resources Program of the European Union, to collect, conserve and use the genetic resources of the olive tree. With the support of the Common Fund for Commodities, other countries of the Southern Mediterranean have been associated. Identification, characterization, collection, conservation and use of genetic resources of olive were done and showed that olive genetic material encloses about 1200 accessions identified in the different olive-growing countries. The conservation in ex-situ collections is essential for the optimal management and use of their genetic resources. These accessions are being collected and preserved in three international collections: Cordoba, Marrakech and Izmir.
The World Olive Marrakesh Collection, the southernmost of the Collections, is of supreme importance to enrich the regional varietal range with varieties that are potentially efficient and adapted to the southern ecological conditions. Also, this collection constitutes a reservoir to be used by future generations in response to biotic or abiotic constraints and adversities that can appear by identifying and selecting genotypes resistant to these possible diseases. In addition, this heritage is available to the scientific community for the study of the different aspects of genetics of the olive tree.

The Marrakech Collection was inaugurated in 2002. It is installed in the Experimental Domain of Tassaoute , INRA Center of Marrakech, Province of El Kalaa of Sraghna, 70 km east of Marrakech. The first plantations are realized in 2003. At present, 9 Ha are planted. The plantations are realized as and when the plants of the different collaborating countries are received. The planting design carried out between 2003 and 2005 is in quartets (Parcel I). While in plot II, where planting started in 2008, block plantations (four blocks and one plant per block accession) were adopted. The plantation situation by country of origin / accession's number

since the installation of the collection is as follow: Italy: 167; Spain: 89; Cyprus: 31; Greece: 17; Portugal: 15; France: 13; Tunisia: 44; Morocco: 41; Algeria: 44; Croatia: 16; Egypt: 19; Slovenia: 10; Syria: 70 and Lebanon: 15. Thus, the total number of accessions planted to date is 591 originating from 14 Mediterranean countries. The total number of accessions received was 661; the overall death rate was 10.5%. These mortalities are mostly recorded before planting. The causes of mortality are related to transport conditions and their condition upon receipt. Of the 591 accessions, 413 are represented by four trees at the period of planting.

It should be noted that the rhythm of plantings has declined considerably in recent years because of the lack of transfer of genetic material by the collaborating countries. Collaboration between the three collections of Marrakech, Córdoba and Izmir has been established since 2015 for the exchange of plant material between the three collections.

Several scientific works are carried out at the level of the collection. They concern different aspects and are carried out in collaboration with national and international institutions in the framework of cooperation bilateral or international research projects. Among the aspects studied, we note: The behavior of accessions under local conditions (yield, alternate bearing, and early entry into production…); molecular characterization and phenotyping-genotyping association; resistance to diseases and pests; floral compatibility between varieties; climate change in relation to phenological stages…One of the most important studies in this collection is the identification of a core-collection representing its diversity. Work is in progress to set up these collections in different sites.

The difficulties noted concerning the management of the collections through our experience are: the reception of a non-uniform plant material (some accessions are grafted, and others were issues from cuttings); the problems of transportation of the plants; the replacement of the missing plants requires infrastructures for their multiplication; some plants are not authentic; possibilities of errors during planting; labeling of plants; difficulties of taking observation in the field especially for block plantings design; requirement of great human and material resources for the management of the collections which it is not easy to obtain. Some publications about WOGB of Marrakech

El Bakkali Ahmed, Moukhli Abdelmajid, Zaher Hayat, Hadidou Amal, Sikaoui Lhassane. 2019.Les ressources génétiques : un atout pour les programmes d'amélioration génétique et de sélection variétale de l'olivier au Maroc. Olivae, 125 : 28-31. Juin 2019.

Sikaoui, L. 2019.La collection mondiale de l'Olivier de Marrakech: une plateforme pour la conservation et l'exploitation des ressources génétiques de l'olivier. Olivae 125 : 32-33. Juin 2019.

El Bakkali A, Haouane H, Moukhli A, Costes E, Van Damme P, Khadari B. 2013. Construction of core collections suitable for association mapping to optimize use of mediterranean olive (*Olea europaea* L.) genetic resources. *Plos One* 8(5): e61265.

Haouane H, El Bakkali A, Moukhli A, Tollon C, Santoni S, Oukabli A, El Modafar C, Khadari B 2011. Genetic structure and core collection of the World Olive Germplasm Bank of Marrakech: towards the optimised management and use of Mediterranean olive genetic resources. *Genetica* 139:1083-1094.

Khadari B, Charafi J, Moukhli A & Ater M. 2008. Substantial genetic diversity in cultivated Moroccan olive despite a single major cultivar: a paradoxical situation evidenced by the use of SSR loci. *Tree Genetics & Genomes* 4: 213–221.

Belaj A., Veral-Gurbuz M., Sikaoui L., Moukhli A., Khadari B., Mariotti R., Baldoni L. 2016. Olive Genetic Resources. In Rugini E., Baldoni L., Muleo R., Sebastini L. (eds). *Olive Tree Genome*, p. 27-54. DOI: 10.1007/978-3-319-48887-5_3

❖ **Palestine**

❖ Portugal

Antonio Manuel Cordeiro

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Curator: António Manuel Cordeiro, PhD, Researcher of INIAV. P.O. Box 6, 7351-901 Portugal

The INIAV, I.P. is the state laboratory that has the mission of research in the areas of the agricultural and veterinary resources. The strategic research units and services of INIAV (UEIS) promote the activities of research, development, experimentation and innovation. The UEIS Biotechnology and Genetic Resources's mission is the conservation, the evaluation, the economic value of national resources and the development of breeding programs. Officially is responsible in charge of the conservation of the olive genetic resources in Portugal.

The CPRCO collection represents the national olive germplasm collection of reference. The CPRCO include experimental fields for conservation and evaluation of the diversity. The 1st phase of the establishment of the CPRCO field plot for agronomic evaluation began in 2012 with 35 accessions of national origin and 20 foreign accessions, proceeded from of varieties adaptation trials established in INIAV Elvas Reguengo farm during the 60's and 70's years of the twentieth century. In the following years, 2013 to 2018, the collection has been expanded by accessions from national prospecting surveys. Nowadays, this collection accounts around 160 Portuguese accessions and 40 foreign accessions from 9 different countries. The CPRCO included too, a conservation collection of intra varietal diversity for three national cultivars with 90 accessions.

The autochthonous material included in the CPRCO collection is being characterized / identified by morphological descriptors applying the UPOV Olive Guidelines (TG/301/1) in two consecutive campaigns and molecular descriptors by SSRs markers. Previously to the main national olive cultivars, morphological characterization IOC Resgen methodology was applied (Fausto et al., 2005). The list of microsatellite markers (SSR) used the collection are: GAPU71A, GAPU71B, GAPU101, GAPU 103, DCA3, DCA4, DCA8, DCA9, DCA 11, DCA15, UDO43, EMO3 and PA(A)5.

The CPRCO collection, despite being a few years old, is being studied by several Portuguese research teams. The INIAV - Pole Elvas team, in addition to their responsibility for the conservation and management of field collections, is also responsible for their agronomic evaluation with the IOC Resgen methodology. The University of Évora and the Cebal Institute are also involved in oleotechnic evaluation studies.

Varietal records of the most important cultivars present in olive groves were published in Vida Rural Magazine and included in a book published in 2013.

Cordeiro AM, Calado ML, Morais N, Miranda A, 2013**.** As variedades de oliveira de referência, Portugal Oleícola. In: O grande livro da oliveira e do azeite. Portugal oleícola; Böhm J (ed. coord.). pp: 188-220. Dinalivro editora, Lisboa. ISBN:978-972-576-620-0

Inês, C., Arias-Calderón R, Gomez-Jimenez MC, **Cordeiro AM,** 2017. Coleção Portuguesa de Referência de Cultivares de Oliveira (CPRCO): vigor vegetativo e produção de 31 cultivares na campanha de 2016/17. Livro de Resumos VIII Congresso Ibérico de Ciências Hortícolas, Coimbra, 07-10 junho p.163. ISBN:978-972-8936-27-3.

Ferro M., **Cordeiro A.M.,** Carvalho M.T., Quintans F., Inês C., Peixe A., Duarte M.F. 2018. Characterization of monovarietal extra virgen olive oil phenolic profile from Portuguese olive tree cultivars. 6th International Conference on the Olive Tree and Olive Products, Olive Bioteq'18, Seville, Spain, October 15th-19th

Milinovic J., Garcia R., Freitas F., **Cordeiro A.M.,** Carvalho T., Gomes da Silva M., Peixe A., Cabrita M. J. 2019. Stability of volatile organic compounds in cultivars of monovarietal extra virgin olive oils from Alentejo, Portugal (submitted).

Milinovic J., Garcia R., Freitas F., Gomes da Silva M., **Cordeiro A.M.**, Carvalho T., Cabrita M.J. 2019. Volatile organic compounds in cultivars of Portuguese Extra Virgin Olive Oils: "Green odor" compounds in the lipoxygenase pathway (submitted).

❖ **Slovenia**
Vesel Viljanka

❖ Spain

Colección Alameda del Obispo-Córdoba

Angjelina Belaj (IFAPA)

Current status of the World Olive Germplasm Collection of IFAPA (WOGC-IFAPA)

Location: Centre IFAPA "Alameda del Obispo" Córdoba (37º 51' 39" N, 4º 48' 30" W).

Curator: Angjelina Belaj

PhD, Tenured researcher of IFAPA.Centre IFAPA "Alameda del Obispo" Córdoba

The Olive World Germplasm Bank of Cordoba (WOGB-Spain) represented the first international attempt of conservation and management of the olive germplasm through a FAO-INIA project and with the IOC support (Del Rio 1994; Caballero et al. 2005; 2006; IOC 2011). This germplasm collection was established in 1970 in Córdoba at the Agricultural Research Centre "Alameda del Obispo" which at the time belonged to INIA (National Agricultural Institute). During all these years, in collaboration with the above-mentioned international institutions, both INIA and the Regional Government of Andalusia (Junta de Andalucía) have been in charge and supported the maintenance and increase of this germplasm collection (Caballero et al., 2006). From 2003, the Andalusian Institute for Agricultural Research (IFAPA), belonging to the Andalusian Ministry of Agriculture, harbours this international collection located at "Alameda del Obispo". In 2014, an agreement between IOC, the Andalusian Ministry of Agriculture, the University of Córdoba (UCO) and IFAPA acknowledged the World Olive Germplasm Banks (WOGB-CAP-UCO-IFAPA). Actually, the World Olive Germplasm Bank of Córdoba includes: WOGC-IFAPA field collection, its backup at IFAPA Centre "Venta del Llano" (Mengibar, Jaén) as well as the field collection and the public Conservatory of Commercial varieties of the Andalusian Ministry of Agriculture established at Rabanales (UCO) campus. In addition, the WOGC-IFAPA collection belongs to the INIA network of olive germplasm collections representing the national olive germplasm collection of reference (ESP-046). IFAPA is the Institution officially in charge of the conservation of olive genetic resources at national (Spanish) level.

From its initials, more than 45 years ago the WOGC-IFAPA collection has been nourished by cultivars collected from Spanish and international prospecting surveys (Barranco and Rallo 2000; Belaj et al. 2003a; Barranco et al. 2005;Ninot et al., 2018) as well as accessions provided by the Network of Olive Collections through EU-IOC RESGEN projects and different Scientific Institutions (Caballero et al. 2005; 2006; IOC 2011). Nowadays, this collections accounts around 1000 accessions from 26 countries in the field, being 35.5% of them of national (Spanish) origin. Besides, the backup collection established at IFAPA Centre "Venta del Llano" accounts around 450 cultivars in the field. And it is being enlarged through prospecting surveys in Andalusia (Gómez-Gálvez et al., 2018) and collaboration with olive germplasm collections included at EU-Before project.

The WOGC-IFAPA collection has systematically been studied by several Spanish research teams Thus, the IFAPA team, apart from its responsibility for conservation and management of the collection, has also been in charge for its agronomic and oleotecnic evaluation (Caballero et al., 2006; Beltran et al., 2016; León et al., 2018). While, traditionally the University of Córdoba has been actively involved in the characterisation and identification of olive cultivars (Trujillo et al., 2014) as well as phenology and disease and pest resistance studies (Barranco et al., 2005). Although different morphological (Barranco et al., 2000; 2005) and molecular descriptors have been used in this collection (Belaj et al., 2016), the SSRs have played an important role for its identification (de la Rosa et al., 2002; Belaj et al., 2003; 2004). Thus, based on their discrimination capacity, the application of five and ten SSR loci was enough to discriminate 79 and 93% of 499 accessions of WOGC-IFAPA collection, respectively (Trujillo et al., 2014). While the use of 17 SSR loci allowed to distinguish between all the accessions under study, including possible somatic mutations. The use of this set of loci in combination with 11 endocarp traits have been suggested as useful protocol for management of olive germplasm banks (Trujillo et al., 2014).

Recently, within the OLEAGEN project and taking advantage of advances in marker technologies, the IFAPA team has been involved in studies for developing practical and cost-effective fingerprinting techniques. Thus, the development and use of DArT markers made possible the identification of 323 olive cultivars and detection of homonymy, synonymy and mislabelling cases (Atienza et al., 2013). In addition, ESTs (Muñoz-Mérida et al. 2013) sequences have been used as a source of long core repeat SSRs (De la Rosa et al. 2013), and SNP markers (Belaj et al., 2018). In this sense, the 1043 new EST-SNPs were able to reliably discriminate among different accessions (325), to reveal a clear cut off between inter- and intra-

cultivar variation in olive as well as to efficiently detect possible homonymy cases and the presence of redundant germplasm in the collection. Besides, this study made possible the selection of a set of 96 EST-SNP markers which is currently being used for the ongoing identification of our collection (Gómez-Gálvez et al., 2018) in a very cost effective and systematic way.

The plant material maintained at the WOGC-IFAPA collection and its study through multilateral and multi-institutional projects have contributed to the generation of important knowledge and publications in olive such as: The World Catalogue of Olive Varieties (Barranco et al., 2000), el Libro de Variedades de Olivo en España (Rallo et al., 2005) and Olive growing book (Rallo L, Barranco D, and Fernández-Escobar R, editors).

Some recent publications are indicated below:

Belaj A, de la Rosa R, Lorite IJ, Mariotti R, Cultrera NGM, Beuzón CR, González-Plaza JJ, Muñoz-Mérida A, Trelles O, Baldoni L, 2018. Usefulness of a New Large Set of High Throughput EST-SNP Markers as a Tool for Olive Germplasm Collection Management. Front Plant Sci 9: 1320.

Ninot, A., Howad, W., Aranzana, M.J., Senar, R., Romero, A., Mariotti, R., Baldoni L, **Belaj A** (2018). Survey of over 4,500 monumental olive trees preserved on-farm in the northeast Iberian Peninsula, their genotyping and characterization. Sci. Hortic. 231, 253-264.

León, L, de la Rosa R, Velasco L, **Belaj A,** 2018. Using wild olives in breeding programs: Implications on oil quality composition.Front Plant Sci 9: 232.

R. De la Rosa, A Belaj, A. Muñoz-Mérida, O. Trelles, I. Ortiz-Martín, J.J. Gonzalez-Plaza, V. Valpuesta, C. R. Beuzón, 2013. Development of EST-derived SSR markers with long core repeat in olive and their utility for paternity testing. J.Amer.Hort.Sci. 138(4): 290-296.

S.G. Atienza., **R. De la Rosa,** M.C. Domínguez-García, A. Martín, A. Kilian, **A. Belaj,** 2013. Use of DArT makers as a means of better management of the diversity of olive cultivars. Food research International 54 (2): 2045-2053

Colección Rabanales-Córdoba

Diego Barranco (UCO)

The cooperation between the University of Córdoba (UCO) and the Olive Department of the IFAPA began with the Project CEMEDETO (FAO_INIA) in 1969. Since the plantation of the initial World Olive Germplasm Bank (WOGB) in 1970, a continuous joint work on management and sustainable use of olive genetic resources has been a distinctive trait of this Bank. This singularity has promoted numerous works such as the catalog of Andalusian Cultivars (Barranco and Rallo,1984) and the multi-authored book "Las Variedades de Olivo en España" edited by Luis Rallo, Juan M. Caballero, Antonio Martin, Joan Tous and Isabel Trujillo in 2005. The relocation of the Agriculture and Forestry School of UCO to the Rabanales Campus in 2006 led to different agreements among the Andalusian Agriculture Department, IFAPA and UCO for the establishment and shared use of two new facilities: the field collection and the repository of olive cultivars. These facilities complemented and extended the activities of the WOGB. Since 2015, an agreement among the leading institutions (IOC, the Consejería de Agricultura y Pesca of the Andalusian Government the IFAPA and the UCO) recognizes the WOGB as an International Reference Bank of the IOC Network. The reasons for that recognition are based on the value of these new facilities, i.e. a new field collection in Verticillium-free plots, an authenticated and pathogen-free collection and an isolated repository. These new facilities have promoted the access to olive genetic resources to multidisciplinary research groups, students and the nursery industry. A landmark for the WOGB was the publication of the protocols and results of the cataloging of the WOGB (Trujillo et al., 2014). This publication was also aimed to help other germplasm banks to solve problems related to the confusion between denominations and true to type cultivars applying morphological (UPOV _IOC) and molecular (SSRs markers). This presentation complements that of Angjelina Belaj in this International Seminar.

❖ **Syria**

❖ Tunisia

Fathi Ben Amar

The Boughrara olive collection is located in the Sfax region (southeastern of Tunisia). The orchard is planted in rain-fed conditions since its creation in 1992 with a planting density of 104 trees/ha (12m/8m).

The collection contains 200 varieties and ecotypes with 146 local and 54 introduced. The variety lists are presented in Tables 1 and 2, respectively.

Table 1. List of the local olive varieties in Boughrara collection (Tunisia)

Adheffou	chemlali jerba	jemri dhokare béni khdeche	sahli gtar1
balhi sig	chemlali ouled youssef	jemri ben guerdene	sahli sned7
baldi gtar	chemlali sfax	k11pg	sahli daoula 1
Barouni	chemlali Tataouine	k11	sayali
Besbassi	chemlali tunis	k12	semni djebenina
bidh hmam	chemlali zarzis	k14	sidi ameur
bl11	chemlali meliene	k15	sig112
bl14	chemlali mahres	k17	sig113 pg
Bent Louzir	Chetoui	k18	sig113G
bl16G	ck1	k21	sig12 pg
bl16PG	ck11	k9PG	sig13
bl17	ck2	k23 pg	sig14pg
bl19pg	ck3	k3	sig15
bl2	ck5	k30	sig17
bl20	ck6	k32	sig11
bl23	ck7	k5	sig18
bl24	ck8	k51	sig19
bl26	ck9	K55pg	sig1G
bl28	ck10	K56g	sig20
bl30	ck12	K56pg	sig8
bl31	crda gabes	k57	sned3 lattout
bl32g	dhokar ben guerdene	k6	souaba algia
bl32pg	dhokar nafti	k9G	touffahi
bl33	dhokar tataouine	kbiret louzir	tounsi gafsa
bl37	Echahla	Kchinet sig	tounsi nord
bl3pg	fouji asli	kz18	zalmati

bl4	fouji gtar 12	marsaline	zarbout louz
bl6	Fouji sbeitla	menkar rakhma	zarrazi chouamekh
bl8	Foukhari	meski	zarrazi gtar 11
boudaoud	Goussellani	meski zarzis	zarrazi injassi Tataouine
chemchali	h9	meski Daoula 2	zarrazi nord
chemlali balhi	indouri jerba	mfartah blettech	zarrazi sned4
chemlali ouled msallem	injassi hchichina	mlouki blettech	zarrazi sned5
chemlali arbi zarzis	injassi gafsa	neb tataoiune	zarrazi zarzis
chemlali chouamakh	jaddaria chaal	oueslati	Zeitoun Boubezzoula
chemlali Ontha	Jerboui	rkhami	
chemlali graiba	jemri bouchouka	ruby2	

Table 2. List of the introduced olive varieties in Boughrara collection (Tunisia)

Variety	Origin	Variety	Origin	Variety	Origin
Manzanille seville	Spain	Franiivento	Italy	Meslala	Morocco
Lechin	Spain	Coratina	Italy	Nougual	Morocco
Sarsoleno	Spain	Carolea	Italy	Picholine marocaine	Morocco
Cornzuelo	Spain	Lucques	France	Bouchouika	Morocco
Verdial Melez Malaga	Spain	Grossane	France	Haouzia	Morocco
Changlot Real	Spain	Cavon	France	Kaissy	Syria
Vera	Spain	Moncita	France	Sorani	Syria
Verdial	Spain	Verdale	France	Jlot	Syria
Arbequina	Spain	Cyprecino	France	Abousatl Mhazzem	Syria
Lechin Grenada	Spain	Olivière	France	Den	Syria
Blanquetta	Spain	Amelau	France	Mssabii	Syria
Lechin Seville	Spain	Verdante	France	Sigoise	Algeria
Nevadello Blanco	Spain	Picholine francaise	France	Agouroumanocolea	Greece
Gordal	Spain	G 28	France	Koroneiki	Greece
Arbosana	Spain	P 30	France	Kalamata	Greece
Manzanille Cacerena	Spain	Negrouna	Portugal	Soury	Lebanon
Ascolana	Italy	Madural	Portugal	Ayvalic	Turgey
Leccino	Italy	Boussera	Morocco	Asoued Kofra	Lybia

The morphological characterization of 56 varieties and ecotypes was carried out by Trigui and Msallem (2002) in the centers of origin and according to the descriptors of the International Oil Council (IOC). Similarly, the oil physico-chemical characterization *in-situ* was made for 18 varieties and ecotypes by Grati-Kamoun and Khlif (2001). A morphological characterization

work according to the descriptors of the IOC and oil chemical *ex-situ* (in collection) was undertaken since 2016 for all varieties of the collection.

The molecular characterization (SSR) of 84 varieties and ecotypes from the collection was made by Fendri et al. (2010) and has detected several cases of synonymies mainly related to the most cultivated variety 'Chemlali Sfax'. The rest of the varieties and ecotypes in the collection are currently subject to molecular analysis by SSR. Similarly, we are in the process of establishing a molecular database reference for the olive tree in collaboration with the National Gene Bank.

Periodic authentication operations were done in the collection over years. Actually, the collection plan has been finalized.

For phytosanitary aspect, several varieties were subject to viral testing in 2008 and 2018 in the framework of two international projects for certification process and the results were negative.

The future studies for the Boughrara olive tree collection are:

- Better conservation conditions especially in relation to irrigation and borders.

- Multiplication of the varieties and ecotypes of the collection to keep them at the National Gene Bank (BNG), work started in 2017.

- Preparation of an *ex-situ* varietal catalogue for all varieties and ecotypes.

- Preparation of a certification program for severalinteresting local varieties.

Significant references:

Grati-Kamoun, N. et Khlif, M., 2001. Caractérisation technologique des variétés d'olivier cultivées en Tunisie. Revue Ezzitouna (numéro spécial). 69 p Trigui, A. et Msallem, M. 2002. Catalogue des variétés Autochtones et types locaux, 159 p.

Fendri M, Trijillo I, Trigui A, Rodriguez-Garcia, M I and Alche-Ramirez J. 2010. Simple sequence repeat identification and endocarp characterization of olive tree accessions in a Tunisian germplasm collection. HortScience 45 (10): 1429-1436.

Ennouri K, Ben Ayed R, Ercisli S, Ben Amar F, Triki M.A. 2017. Evaluation of Variability in Tunisian Olea europaea L. Accessions using Morphological Characters and Computational Approaches.Not Bot Horti Agrobo, 2017, 45(1):262-269. DOI:10.15835/nbha45110662.

Sion S, Taranto F, Montemurro C, Mangini G, Camposeo S, Falco V, Gallo A, Mita G, Saddoud Debbabi O, Ben Amar F, Pavan S, Roseti V and Miazzi M.M. 2019. Genetic Characterization of Apulian Olive Germplasm as Potential Source in New Breeding Programs.Plants 8, 268; doi:10.3390/plants8080268.

Ben Amar F, Ayachi-Mezghani M, Yengui A et Benbelkacem N. 2014. Diversité génétique des variétés d'olivier originaires de pays arabes présentes dans la collection nationale de l'olivier de Boughrara (Sfax, Tunisie). Olivae 120: 17-21.

❖ Turquie

Melek Gurbuk (ORS)

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Olive Research Institute (ORI) is an institution of Agricultural Research and Policies which is working for Ministry of Agriculture and Forestry. ORI is responsible for; collecting and conserving olive gene resources, conducting research projects in national and international level in the field of breeding and genetics, plant protection, olive growing techniques, food technology, agricultural economics and soil-water resources. Additionally, ORI is organizing training activities for the olive sector and providing stock material to the companies for true-to- type sapling production.

National Olive Germplasm Bank; In the frame of the project "*Collection, Conservation and Characterization of Turkish Olive Gene Resources* ", 92 olive varieties have already been registered so far and conserved in the National Olive Germplasm Bank in Izmir (1 new candidate will be included in Feb, 2020). Endocarp collection is available for each variety as well.

Additionally, 38 new genotypes collected in the survey programs from different regions of the country have been taken under review for the registration procedure in the collection garden. Clonal selections of some important cultivars have been carried out in different regions and 1 superior Memecik (clone 9) was included to the National collection in 2017, while the rest of clones have been still under investigation. Wild olive (O.europaea L.subsp.Oleaster) selection from the populations in Black Sea, Marmara and Aegean Regions has been studied to develop rootstock and variety candidate.

Mediterranean Olive Germplasm Bank; It contains 33 main foreign cultivars and was established in 1972 by IOC initiation.

World Olive Germplasm Bank; The project was launched in 2012 with the agreement between IOC and Olive Research Institute and since then the varieties have gradually been incorporated into the collection from Albania, the Marrakesh World Olive Collection, Cordoba University and IFAPA. The Izmir World Olive Germplasm Bank is located in the Experimental Station of the Olive Research Institute in the Kemalpasa district. Between 2017-2019, 184

varieties were planted in the field in 2 randomized block design. About 90 varieties are available for the planting in 2020 spring season.

Breeding program; During 1995-2016, total 69 crosses (out of 2683 individuals) of Memecik, Gemlik, Uslu, Ayvalık, Erkence, Manzanilla, Gordal were selected as promising varieties with their superior attributes. Two of them were breeded from "Memecik x Gemlik" called *Hayat* (MG5) and *Arsel* (MG11) with early maturation, bigger fruit size, higher oil yield and, firm and fleshy texture were registered in 2015 and 2018 respectively. Another breeding program was started in 2012 to form F1 population depending on the genetical distance and contrast attributes in terms of fruit size, oil yield, vigour, rooting ability, resistant to verticillium, to be used in association mapping and QTL studies, using Gemlik, Domat, Girit, Karamursel Su, Edincik Su, Cilli and Kilis Yaglık combinations.

The catalogue of Turkish olive varieties was published in 2015 as a result of IOC-RESGEN project, comprising 89 varieties with their passport data, morphological characters (by UPOV-IOC descriptors) and technological attributes. A second edition is planned to be published comprising a 4-year database for the period 2016-2019, plus previous RESGEN results, with extended information including chemical and sensorial analysis of olive oil, and be issued after compiling all the results.

The molecular analysis of Turkish olive germplasm using three different marker techniques (AFLP, SSR and cSNP) in combination has resulted more precise assessment of the genetic diversity and more comprehensive transcriptome sequencing data (Kaya et al, 2013). In the study, a high level of genetic variation was found between the 89 varieties obtained from National Olive Germplasm. A number of accessions known by the same names were found genetically different, suggesting that these were homonyms; Esek zeytini (Odemis) and Esek zeytini (Tekirdag); Egriburun (Nizip) and Egriburun (Tatayn); Tas arası (Aydın) and Tas arası (Kus adası); Celebi (Silifke) and Celebi (Iznik). *Core collection* of Turkish Olive Germplasm constituted 22 varieties, which was determined within the frame of Turkish-French Bilateral Corporation (BosGenOlive project).

Publications

- Kaya,H.B., Cetin,O., Kaya,H., Sahin,M., Sefer,F., Tanyolac,B., 2016. Association Mapping in Turkish Olive Cultivars Revealed Significant Markers Related to Some Important Agronomic traits, 2016, Biochemical Genetics. Volüme 54, issue 4, pp 506-533.
- Kaya,H.B., Cetin,O., Kaya,H., Sahin,M., Sefer,F., Kahraman.A., Tanyolaç.B., 2013. SNP Discovery by Illumina-Based Transcriptome Sequencing of the Olive nd the Genetic Characterization of

Turkish Olive Genotypes Revealed by,AFLP,SSR and SNP markers., PLoS One. 2013 Sep 13;8(9):e73674. doi: 10.1371/journal.pone.0073674.

- Isık, N., Doganlar, S., Frary, A., 2011. Genetic diversity of Turkish Olive Varieties assessed by simple sequence repeat and sequence-related amplified polymorphism markers. Crop Science 51: 1646-1654.
- Ipek,A., Barut,E., Gulen,H., Ipek,M., 2012. Assessment of inter-and intra-cultivar variations in olive using SSR markers. Scienta Agricola, v.69,n5,p.327-335.
- Catalogue of Turkish Olive Varieties, 2015. Olive Research Institute Publication. Pp 200 ISBN: 978-605-9175-04-3.
- Turkish - Franco Bosphorus Joint Project (2014-2015). Acronym BosGenOlive. Primary domestication of the olive tree and Mediterranean core collection: towards the setting up of a network for association mapping of agronomic and adaptive traits.

❖ Uruguay

Jorge Pereira

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The National Institute of Agricultural Research "INIA", is an non state public law institute jointly co-governed and financed jointly by the public and private sector created in 1989. It is provided with five scientific-technical centers to service of the sustainable development of the agricultural sector of the country, developing an excellent role in the innovation processes, trending to the joint with other actors of the science, technology and innovation systems, compromised with the quality of its human capital, its processes and products. From its foundation it has had the vocation of generating information to direct use for the producer and improve the results in the production. This materialized in diverse actions that point at the prioritized problems by every sector and productive chain in particular. The National Investigation Program in Fruit Production includes between the relevants chains the olive tree, destining part of its resources and efforts to investigate different aspects of the process that culminates with the putting of extra virgin oil of high quality in the table of the Uruguayan consumer. One of the proposes of the productive process is the genetic material that is used. The importance of the varieties adaptation used, to the local agro ecological conditions is a topic that he cannot forget.

For this reason INIA initiated a long term process in the first decade of the XXIst century, installing collections of varieties that were introduced at the experimental stations INIA-"Las Brujas", Canelones (34°40' S; 56°20' O) on a Vertisol Eútric soil, with ph: 6,5 and 2,5% content of organic matter and in INIA "Salto Grande", Salto, (31°16' S; 57°53' O) on a Argisol Dístrico Ócrico Abrúptico soil (húmico) with ph: 5,4-6,0 a content of organic matter of 1,5-1,8 (Durán, 1991). Under a intensive system S6 with located irrigation and commercial agronomic handling (COI, 2015 firstly in 2002 and later in 2006, an evaluation garden was carried out in each of the mentioned centers.

In 2008 cooperation programs began with the Agronomy Faculty of the University of the Republic (UDELAR) in Physiology, Phytopathology, Biotechnology and Genetic Resources matters. At present exist 31 cultivars: 6 introduced in 2002 (Arbequina, Barnea, Manzanilla, Frantoio, Lecciono and Picual) 14 in 2005 (Cipressino, Bosana, Canine, Ascolana, Coratina, Frantoio, Grignan, Itrana, Maurino, Moraiolo, Seggianese, Pendolino, Taggiasca, Tanche) and 11 in 2006 (Changlot Real, Arauco, Empeltre, Farga, Mission, Holly, Koroneiki, Arbosana,

Alfafara, Picholine and Carolea) originated from the CNR. CO.RI.PRO, Italy and national nurserys.

In 2012 began a prospect project of bicentenary olive groves existing in Uruguay with the cooperation of Agronomy Faculty with founds of UDELAR, National Agency of Investigation and Innovation (ANII) and International Olive Oil Council (RESGEN). In 2016 was installed one field essay with of nine genotypes originated from different areas of the country.

The initial step in this long-term project was the morphological description of olive cultivars with features of the tree, leaves, flowers, fruit and seeds as described in Barranco et al. (2000, 2005). For genotyping, molecular descriptors have been used in this collection (Belaj et al., 2016). The SSRs have played an important role for its identification and a combination of morphological and genetic characterization of olive cultivars was also employed to achieve higher accuracy (Pereira et al., 2013, 2015, 2018 and Bernal, 2017)). For genotyping, molecular descriptors have been used in this collection (Belaj et al., 2016). The SSRs fourteenteen microsatellite loci were selected on the basis of their informativeness and previous experience in our group (DCA3, DCA5, DCA9, DCA14, DCA16, DCA18, Gapu101, UDO043, EM090, GAPU71B). Thus based on their discrimination capacity, the application of 4 loci was enough to discriminate 91% of 31 accessions of INIA collection (Pereira, 2014). The use of this set of loci in combination with 20 leaf, fruit and endocarp traits have been suggested as useful protocol for management of olive germplasm banks (Pereira, 2015).

Recently in cooperation with IFAPA (Alameda de Obispo) the nine Uruguayan bicentennial genotypes were analyzed with new EST-SNPs markers and the results are in evaluation (unpublished data). Previously with morphological and SSRs markers we conclude that Uruguay has preserved a unique and original gene pool, currently productive and adapted to local soil and climatic conditions. This pool is a heritage of global interest, suitable for commercial and cultural purposes.

The field collection has been tested for tree diseases: olive scab, leaf spot, and anthracnose and is currently under new laboratory testing by the Plant Pathology Lab of INIA

In the future, characterization and utilization of plant genetic resources is expected to markedly benefit from the exploitation of new tools such as EST-SNPs (Belaj et al. 2018). Commercial accessions continue in phonological and agronomic evaluation. The nine original genotypes are in field trials (2 and 3 years old). Five of them are in bloom. The fruit will be evaluated next year, morphologically, fat yield and oil quality.

Some relevant publications are:

Catálogo de cultivaros de olivos. Evaluados en INIA-URUGUAY. 2019. CONDE, P.; VILLAMIL, J.J.; BRUZZONE, J.; LEONI, C.; ZOPPOLO, R.; VILLAMIL, J. (Eds.). Boletín de Divulgación N°:117. ISBN: 978-9974-38-405-7. ISSN:1510-7396. http://www.inia.uy/Publicaciones/Paginas/publicacionAINFO-59932.aspx

Response of Olive (*Olea europaea*) Cultivars Against *Venturia oleaginea* Causing Olive Scab in Uruguay. 2019. BERNASCHINA, Y., ALANIZ, S.; CONDE, P.; C. LEONI Agrociencia, v.: 23 1 , p.:1 - 9, 2019. DOI: 10.31285/AGRO.23.1.13 http://www.scielo.edu.uy/scielo.php?script=sci_abstract&pid=S2301-15482019000100047&lng=es&nrm=iso&tlng=en

Percentage of anthracnose (*Colletotrichum acutatum s.s.*) acceptable in olives for the production of extra virgin olive oil. 2018. LEONI, C.; BRUZZONE, J.; VILLAMIL, J.J.; MARTÍNEZ, C.; MONTELONGO, M.J.; BENTANCUR, O.; P. CONDE. Crop Protection, v.: 108 p.:47 - 53, 2018. ISSN: 02612194 DOI: 10.1016/j.cropro.2018.02.013 https://authors.elsevier.com/a/1Wc55xPFYej-J Crop Protection Volume 108, June 2018, Pages 4753.

Caracterización morfológica y molecular de variedades italianas de olivo (Olea europaea L.) instaladas en el jardín de introducción de INIA Las Brujas. 2017. BERNAL MARTÍNEZ, J Tesis de grado, Universidad de la República (Uruguay). Facultad de Agronomía. https://www.colibri.udelar.edu.uy/jspui/bitstream/20.500.12008/18615/1/TTS_BernalMart%c3%adnezJennifer.pdf

Original olive genotypes found in Uruguay identified by morphological and molecular markers. 2018. PEREIRA, J.; BERNAL, J.; MARTINELLI, L.; VILLAMIL, J.J.; P. CONDE. Acta Hortic. 1199, 7-14. DOI:10.17660/ActaHortic.2018.1199.2 https://doi.org/10.17660/ActaHortic.2018.1199.2.

Evaluación de descriptores moleculares y morfológicos de variedades de olivo en Uruguay.2013. Baccino, S; Scaltritti, J; Silveira, A. López, S. Gándara, J. y J. Pereira. In: INIA (Instituto Nacional de Investigación Agropecuaria); Programa Nacional Producción Frutícola. Resultados experimentales en olivo. Jornada de Divulgación. Canelones (Uruguay), 2013. p. 9-20 (Serie Actividades de Difusión ; 721).https://www.academia.edu/8454428/EVALUACION_DE_DESCRIPTORES_MOLECULARES_Y_MORFOLOGICOS_DE_VARIEDADES_DE_OLIVO_EN_URUGUAY

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