DELIVERABLE 5.1

Title: List of existing databases on olives and olive oils

Date: April 12th 2017

LEAD BENEFICIARY:

Eurofins

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OTHER BENEFICIARIES

CSIC, CONICET, Fera, ITERG, JRC, Lablicate, UNIBO, UNIUD

Project funded by the European Commission within the Horizon 2020 Programme (2014- 2020)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (Including the Commission Services)	
RE	Restricted to a group specified by the consortium (Including the Commission Services)	
CO	Confidential, only for members of the consortium (Including the Commission Services)	

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Executive summary

One objective of the OLEUM project is to establish an open access databank to store not only the information generated by the OLEUM consortium but also to be interoperable with already existing databases related to the characterisation of the olive tree germplasm and olive oils.

This deliverable specifically summarises information on existing databases related to *Olea europaea* mainly curated in Europe but also in other part of the world. Information was gathered via the partners of the OLEUM consortium as well as available publications and internet consultations.

A total of 15 databases have been identified, of which 10 are web-based and currently accessible. However, an accessible database does not mean that necessarily the available information can be partially or entirely re-used in another database; reason why it is essential to contact each curator as a second step.

In order to identify an unknown monovarietal virgin olive oil cultivar, several reference databases have been established providing morphologic, DNA molecular markers and/or chemical data of worldwide olive trees and oils. The olive cultivar identification and olive oil authentication are especially important for protection of certified brands such as Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI).

Apparently, there is no database centralising the passport data of all the olive accessions distributed in the existing germplasm banks of olive. However, considering the information gathered, it seems that a significant percentage of the olive germplasm is conserved in the European germplasm banks; the two most important ones being the Worldwide Olive Germplasm bank of Cordoba and the CRA-OLI collection, for which elaiographic cards are also available. These cards include morphological and agronomical data as well as a variety of molecular and chemical descriptors. A huge amount of work has been carried out in the past two decades to characterise cultivars by molecular markers, however results are disseminated in several databases or scientific publications.

Several databases are storing data on chemical composition of olive oils from conventional chemical analyses; e.g. fatty acids, triglycerides, organoleptic oil values. Only one database (i.e. Italian National Database of PDO/PGI Extra Virgin Olive Oils) is maintaining data from isotopic measurements as well as from a metabolomics approach.

By sharing or even integrating olive databases in the sense of the data FAIR principles recommended by the Horizon 2020 framework, it is expected to provide proper references to data, to allow them to be reused, to increase their reproducibility and to promote collaborations. Several technical platforms, portals and tools currently available for achieving such data management are discussed in the deliverable. Further tasks are also described for collaborating and exchanging data with curators of identified databases and to explore not yet listed databases.

Introduction

The ability to harvest the wealth of information related to food frauds will advance our understanding of this domain of criminality as well as our capacity to fight more efficiently against fraudsters; however, lack of appropriate tools, poor data accessibility, and insufficient training, are major impediments to rapid translational and transnational impacts.

Storing data for future reuse and reference is a critical factor in the success of actions related to food authenticity. Recently, the U.S. Pharmacopeial Convention (USP) released the second version of the Food Fraud Database[1] that continuously updates collection of thousands of ingredients and related records gathered from scientific literature, media publications, regulatory reports, judicial records, and trade associations from around the world. However the database is available through an annual subscription. The Food Protection and Defence Institute (FPDI) at the University of Minnesota launched the Food Adulteration Incidents Registry (FAIR)[2]. Information for this database is a compilation of historical and current events involving economically motivated and intentional adulteration of foods on a global scale. Incidents which occurred more than five years ago are available for free. Subscribers have access to all available incidents including visualization. There are currently (April 2017) over 530 unique incidents.

Motivations for these efforts include providing proper references to data discussed in publications and allowing published data to be reused for new discoveries, sometimes under specific accessibility rules.

Horizon 2020 already mandates open access to all scientific publications but now, from January 2017, this will be extended to all research data, with the possibility to opt out[3]. The European Commission believes this offers better value for money, encourages collaboration across disciplines, is in the public interest and is essential for solving today's complex societal challenges.

The OLEUM project includes among its objectives the establishment of a web Open Access databank aiming to store the information generated by the OLEUM consortium. In addition of the already mentioned motivation in the previous paragraph, another motivation for storing data is reproducibility: having data and information on how the data were produced and analysed—so-called metadata—enables replication studies.

Although having detailed metadata on content, provenance and sample relations enables both replication and reuse, thereby increasing the data's scientific impact, scientists will in reality weigh these benefits against the labour required to report and maintain the metadata. Clearly, existing information should be easily reusable without having to provide them again. Moreover, inherent relationships should be captured and the origin and progression through time should be recorded as it happens. Further, metadata reporting should be possible in stages with the involvement of different people and without requesting all details upfront. Free text descriptions of content should be possible, but relevant ontologies and controlled vocabularies should be available and used for structuring reporting and maintaining uniformity. Additionally, data providers having sensitive and private data should be able to report the presence of the data without violating ethical or legal requirements by exposing the data itself. Finally, the reporting process should be possible as part of routine work and not something left until there is an obligation to do so.

[1] https://www.foodfraud.org/#/food-fraud-database-version-20
[2] https://foodprotection.umn.edu/fair
[3] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf

At the same time, the technologies and methods used in research are becoming more advanced and increasing in number. This increases the complexity and quantity of the data produced, which tend to take a variety of formats. In addition, lack of a central catalogue for research data, inability to host sensitive data on public servers, and privacy and security concerns make it hard to locate existing data leading to redundancy in research and ambiguity in resources used.

In this context, the WP5 in charge of the establishment of the OLEUM database conducted a survey on **existing databases on olive germplasm** and **compositional data on olive oils** to evaluate which information is potentially available, where such information is stored and what could be the relevance for the OLEUM project. In addition, when it was available, technical information on the databases was also analysed as it exchange/transfer of data will be evaluated with the curators.

Indeed, the OLEUM project is revising existing analytical methods for verifying olive oil quality and detecting fraud by identifying drawbacks and improving performance and efficiency. Moreover, OLEUM is also developing, among the others, novel analytical markers for detecting illegal blends, evaluating olive oil freshness and best-before quality, and for monitoring compliance with labelled geographical origin.

Consequently, it is of upmost importance to collect information on existing data related to:

- The traditional methods that OLEUM aims at improving: sensory panel test; biophenols by high-performance liquid chromatography (HPLC); fatty acid ethyl esters by gas chromatography (GC); global methods for triglycerides by HPLC and fatty acid methyl esters (FAMEs) by GC; sterols and triterpene alcohols by Thin-Layer Chromatography- gas chromatography (TLC / GC);
- The more innovative methods to be adopted during the OLEUM project: Volatile profiles by solid phase micro extraction and gas chromatography–mass spectrometry (SPME-GC/MS), nuclear magnetic resonance (NMR),, GC with an ion mobility spectrometer (GC-IMS), and flash gas chromatography electronic nose (FGC-E-Nose); diacylglycerols and triacylglycerols by flow injection analysis with ultrahigh resolution mass spectrometry (FIA-UHRMS); Steryl esters by solid phase extraction (SPE) and LC-MS-MS; Conjugated fatty acids by GC/HPLC-TOF-MS; Fatty acids ethyl esters by GC time domain reflectometry (TDR) and FT-IR; Next generation sequencing (NGS) data and DNA molecular markers by quantitative real time PCR (qRT-PCR); Polyphenols, chlorophylls and tocopherols by fluorescence spectroscopy method; Free acidity and peroxide value by electrochemical sensors; Fingerprint data obtained by NMR and FT-IR.

This deliverable reflects the current situation and should not be considered as a frozen document but at contrary it will be a dynamic catalogue that should extend in parallel with the negotiation procedure with the curators on the accessibility agreement of their database. Indeed this procedure should on short/medium term encourage collaboration and increase trust among partners.

Approach and methodology

A MS Excel sheet was designed to report the following information from partners of the OLEUM project following as much as possible the BioDBcore guidelines[4], detailing (among other information):

- Name of an existing database;
- Type of records: Germplasm, Genetic, Composition of olive oils;
- General description of the records;
- URL of the database;
- Number of records;
- Main fields;
- Type of queries and retrieves;
- Access right management and security systems;
- Owner of the database;
- Country;
- Analytical dataset (yes/no);
- Publications referring to the database;
- Contact data;
- Copyright (Terms of use).

To facilitate the gathering of information avoiding duplications, the MS Excel sheet was shared on Google Disk allowing each participant to see in real-time the already registered information. This document was available during two months.

Then the information was harmonised and completed by consulting the URLs of the respective database as well as referring to publications describing a specific database.

In a first attempt, an e-mail was sent to several institutions in Europe (14) and worldwide (7) dealing with olive germplasm or analysing olive oils (**Annex I**). The contacted institutions were extracted from:

- The identified databases via the survey achieved within the OLEUM consortium.
- List of olive germplasm collections that contributed to the OLEA olivodb in Italy (**Annex II**).
- List of chemical testing laboratories recognized by the International Olive Council[5].

This e-mail was addressed to evaluate the responsiveness of institutions to share information related to olive germplasm and olive oils. As already mentioned, the catalogue of olive and olive oil databases should be considered as a dynamic because negotiations will be needed.

[4] Gaudet, P. *et al.*, Towards BioDBcore: a community-defined information specification for biological databases. Database 2011, baq027.
[5] http://www.internationaloliveoil.org/estaticos/view/226-laboratories-panels?lang=en_US

Results and Discussion

Overview of the identified databases

Investigations were pursued in order to draw up the inventory of the databases related to olive germplasms, olive oils and their chemical and organoleptic characteristics. A total of 16 databases have been identified, of which 10 are web-based and currently accessible (**Table 1** and **Annex III**). However, an accessible database does not mean that necessarily the available information can be partially or entirely re-used in another database; reason why it is essential to contact each curator.

TABLE 1: OVERVIEW OF THE IDENTIFIED DATABASES ON OLIVE GERMPLASMS AND OLIVE OILS.

Database	Web access	Country	Germplasm	Genetic	Oil composition
OLEA	Yes	Italy	x		
OLEA SSR markers	Yes	Italy	x	x	
WOGBC - Worldwide Olive Germplasm Bank of Córdoba, Marrakech and Izmir	No	Spain, Morocco & Turkey	x	x	
National Clonal Germplasm Repository - Tree Fruit & Nut Crops & Grapes	Yes	USA	x	x	
Istrian Olive Database	Yes	Croatia & Slovenia	x	x	
CRA-OLI collection	No	Italy	x	x	x
Australian DNA Fingerprints of Olive Cultivars	No	Australia		x	
Certolio	Yes	Italy		x	
ReprOlive	Yes	Spain		x	
Olive Genetic Diversity Database (OGDD)	Yes	Tunisia		x	x
FATG-DB04	No	France			x
Oli monovarietali italiani	Yes	Italy			x
Sistema Informativo Agricolo Nazionale (SIAN) ICQRF	Yes	Italy			x
Italian National Database of PDO/PGI Extra Virgin Olive Oils	No	Italy			x
EuroFIR	Yes	Belgium			x

Germplasm databases

Investigations of the partners led to identify three groups of databases where information on olive germplasms had been collected:

- The first one is the **Olea database** (http://www.oleadb.it/). It is the most comprehensive database on germplasm. It has two main sections: one on the germplasm itself and a SSR-marker database (**Figure 1**).
- The second database is a subpart of the American **National Clonal Germplasm Repository - Tree Fruit & Nut Crops & Grapes**. Collection of vegetal material *ex situ* from worldwide *Olea europaea* trees and molecular data are present. This base can be accessed and searched through the web.
- The third group is the **Worldwide Olive Germplasm Bank** (WOGB). Accessions are conserved in live collections in different countries (Spain, Morocco and Turkey). Started in 1970, there is no web access to these banks, but it is currently one of the largest olive germplasm banks.

OLEA database

The OLEA database is a comprehensive olive (*Olea europaea* L.) science portal established in 2007 by olive researchers in Europe, led by Istituto per la Valorizzazione del Legno e delle Specie Arboree (IVALSA, Italy).

It contains 1,841 references of 1,607 cultivars. But apparently, the database is not updated since 2012 (last date of a publication in the bibliography section of the web site). It can be accessed on the Web without registration. No experimental analytical dataset is available.

It is possible to search collection by scientific parameters. A query must be composed with up to three parameters, including morphological agronomical parameters, biotics or abiotics stress, biochemical characters, molecular markers, cultivation area and country (**Figure 2**).

Each germplasm entry in this database includes the following information, detailed in screenshots of the Olea website (**Figure 3** to **Figure 11**):

- **General characters**: purposes, cultivation areas, genetic origin, synonyms, etc
- **Morphological characters**: tree, fruits, leaves etc.
- **Agronomical characters**: rooting, flowering, fertility, oil content etc.
- **Biotic stress**: insects, bacteriums, viruses etc.
- **Abiotic stress**: temperature, wind, salinity etc.
- **Biochemical characters**:
- **Molecular markers**:

Molecular markers are available for each cultivar showing the reported markers among SSR, SNP, AFLP, RAPD SCAR or ISSR and give reference to the scientific publication supporting the information.

In the case of the SSR markers, additional information is available, reused from the Olea SSR-marker database (**Figure 11**). For more information about this feature, please refer to the paragraph "Genetic databases".

FIGURE 1 : SCREENSHOT OF THE OLEA DATABASE HOME PAGE.

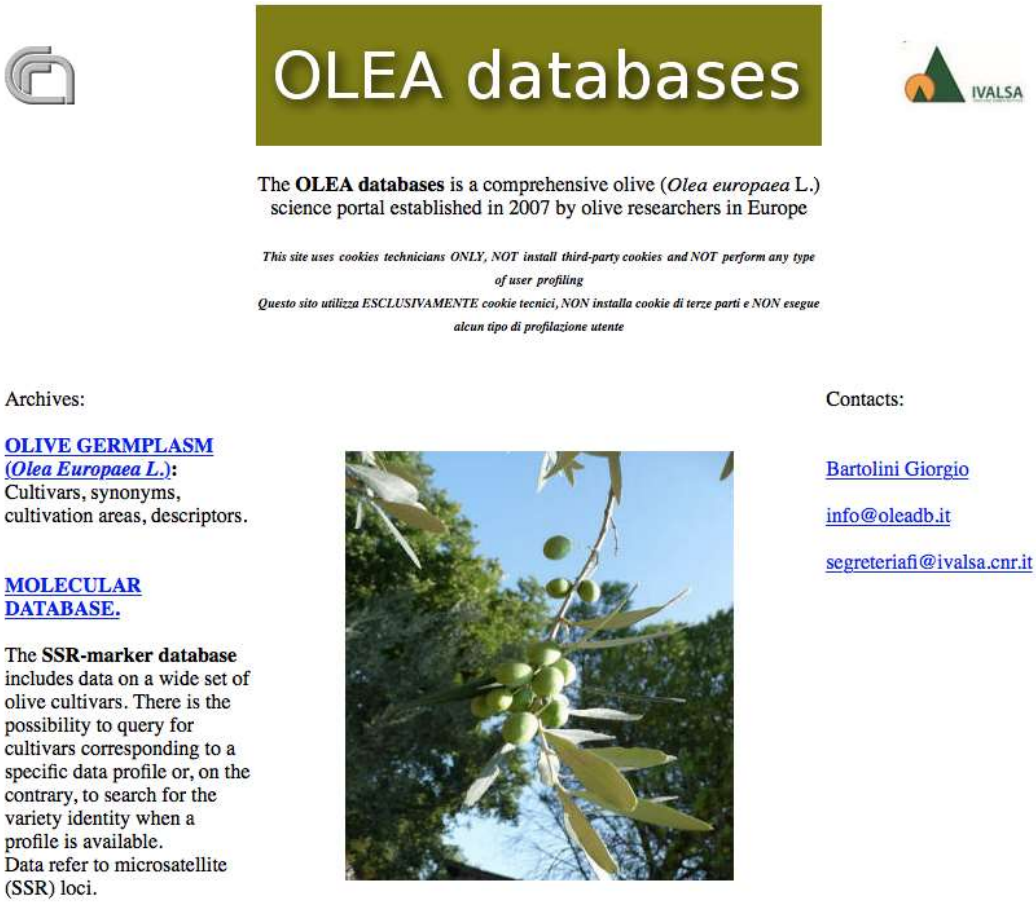


FIGURE 2 : SEARCH COMPOSITION IN THE OLEA DATABASE.

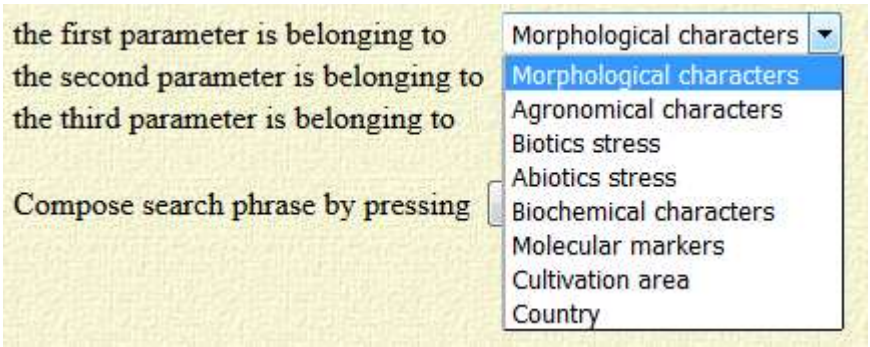
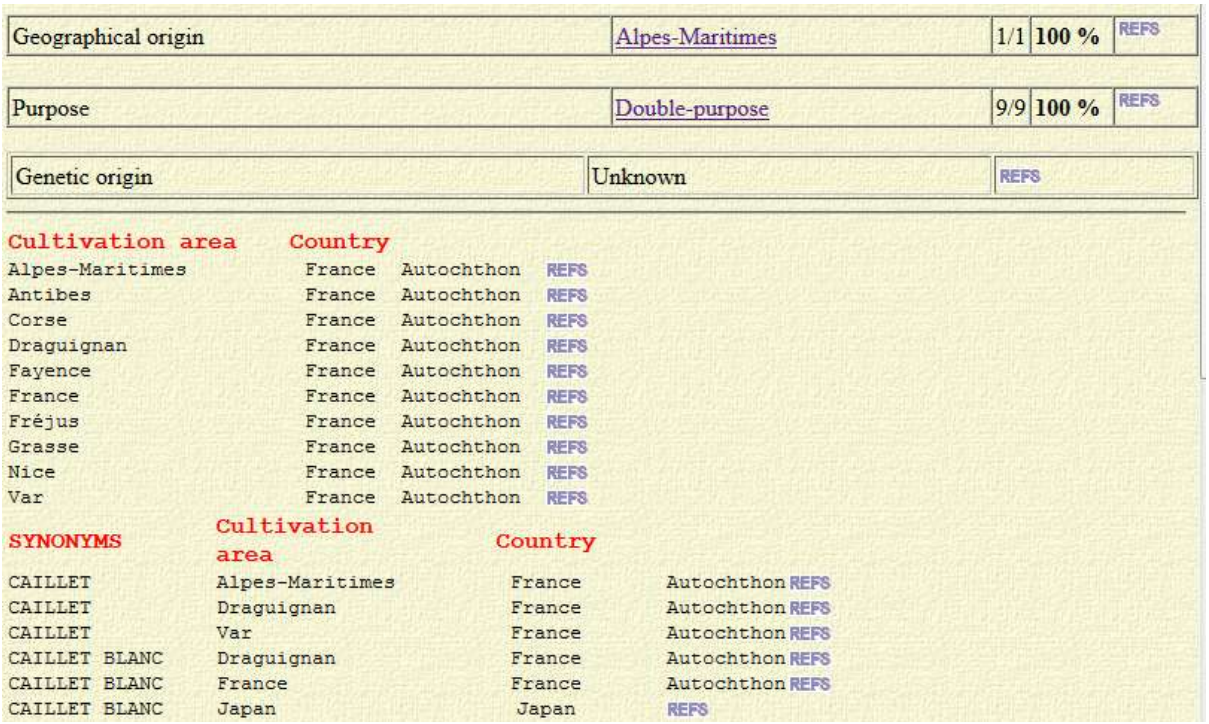


FIGURE 3 : GENERAL CHARACTERS IN OLEA.

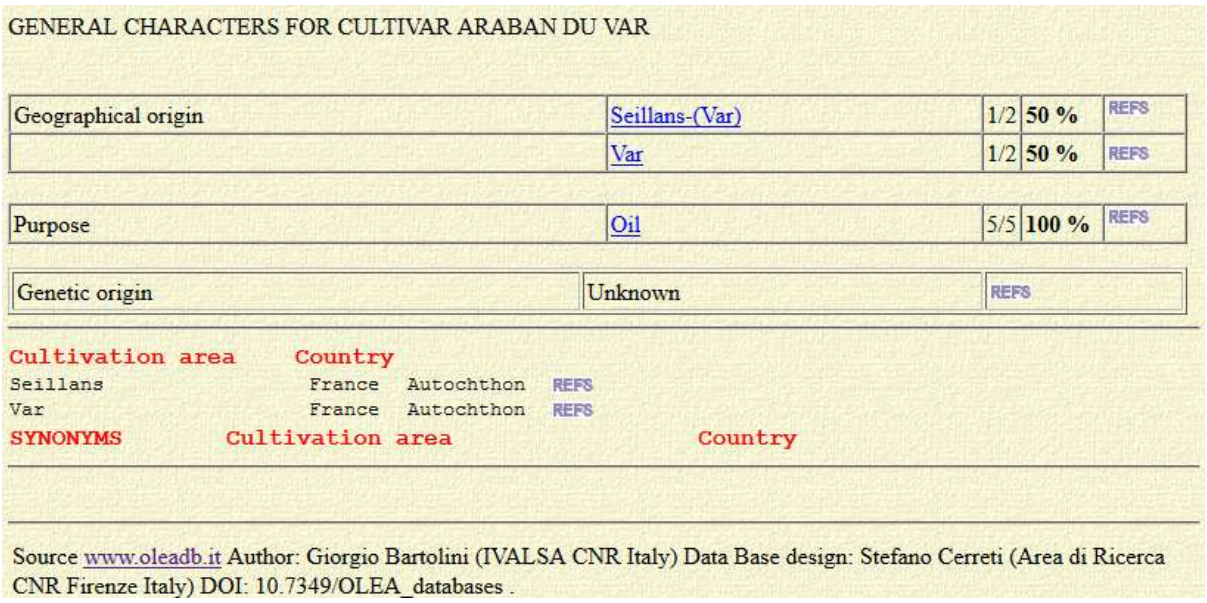


Geographical origin	Alpes-Maritimes	1/1	100 %	REFS
Purpose	Double-purpose	9/9	100 %	REFS
Genetic origin	Unknown			REFS

Cultivation area	Country		
Alpes-Maritimes	France	Autochthon	REFS
Antibes	France	Autochthon	REFS
Corse	France	Autochthon	REFS
Draguignan	France	Autochthon	REFS
Fayence	France	Autochthon	REFS
France	France	Autochthon	REFS
Fréjus	France	Autochthon	REFS
Grasse	France	Autochthon	REFS
Nice	France	Autochthon	REFS
Var	France	Autochthon	REFS

SYNONYMS	Cultivation area	Country		
CAILLET	Alpes-Maritimes	France	Autochthon	REFS
CAILLET	Draguignan	France	Autochthon	REFS
CAILLET	Var	France	Autochthon	REFS
CAILLET BLANC	Draguignan	France	Autochthon	REFS
CAILLET BLANC	France	France	Autochthon	REFS
CAILLET BLANC	Japan	Japan		REFS

FIGURE 4 : GEOGRAPHICAL ORIGIN IN OLEA.



GENERAL CHARACTERS FOR CULTIVAR ARABAN DU VAR

Geographical origin	Seillans-(Var)	1/2	50 %	REFS
	Var	1/2	50 %	REFS
Purpose	Oil	5/5	100 %	REFS
Genetic origin	Unknown			REFS

Cultivation area	Country		
Seillans	France	Autochthon	REFS
Var	France	Autochthon	REFS

SYNONYMS	Cultivation area	Country

Source www.oleadb.it Author: Giorgio Bartolini (IVALSA CNR Italy) Data Base design: Stefano Cerreti (Area di Ricerca CNR Firenze Italy) DOI: 10.7349/OLEA_databases .

FIGURE 5 : MORPHOLOGICAL CHARACTERS IN OLEA.

MORPHOLOGICAL CHARACTERS FOR CULTIVAR ARABAN DU VAR

Tree-Vigour	Medium	3/3	100 %	REFS

Source www.oleadb.it Author: Giorgio Bartolini (IVALSA CNR Italy) Data Base design: Stefano Cerreti (Area di Ricerca CNR Firenze Italy) DOI: 10.7349/OLEA_databases .

FIGURE 6 : AGRONOMICAL CHARACTERS FOR CULTIVAR IN OLEA.

Oil content (FW)	High	1/2	50 %	REFS
	Medium	1/2	50 %	REFS
Oil-Chemical composition of oil (%) Oleic acid	High	1/1	100 %	REFS
Rooting ability (Induced)	Medium	1/1	100 %	REFS
Tree-Productivity	Intermediate-alternate	1/1	100 %	REFS

Source www.oleadb.it Author: Giorgio Bartolini (IVALSA CNR Italy) Data Base design: Stefano Cerreti (Area di Ricerca CNR Firenze Italy) DOI: 10.7349/OLEA_databases .

FIGURE 7 : SUSCEPTIBILITY TO BIOTIC STRESS FOR CULTIVAR IN OLEA.

Bactrocera oleae	High	5/6	83 %	REFS
	Medium	1/6	16 %	REFS
Pseudomonas syringae	High	1/2	50 %	REFS
	Low	1/2	50 %	REFS
Saissetia oleae	High	3/3	100 %	REFS
Sooty moulds	High	2/2	100 %	REFS
Spilocaea oleaginea	High	2/2	100 %	REFS

FIGURE 8 : SUSCEPTIBILITY TO ABIOTIC STRESS FOR CULTIVAR IN OLEA.

Cold	High	3/6	50 %	REFS
	Low	1/6	16 %	REFS
	Medium	2/6	33 %	REFS
Drought	Low	1/1	100 %	REFS

FIGURE 9 : BIOCHEMICAL CHARACTERS FOR CULTIVAR IN OLEA.

Biochemical characters ADH	--	1/1	100 %	REFS
Biochemical characters EST	--	1/1	100 %	REFS
Biochemical characters GPI	--	1/1	100 %	REFS
Biochemical characters LAP	--	1/1	100 %	REFS
Biochemical characters MDH	--	1/1	100 %	REFS
Biochemical characters PGM	--	1/1	100 %	REFS

FIGURE 10 : MOLECULAR MARKERS FOR CULTIVAR IN OLEA.

MOLECULAR MARKERS FOR CULTIVAR ARBEQUINA

Molecular markers SSR	19/19	100 %	REFS
Molecular markers SNP	1/1	100 %	REFS
Molecular markers AFLP	6/6	100 %	REFS
Molecular markers RAPD	15/15	100 %	REFS
Molecular markers SCAR	1/1	100 %	REFS
Molecular markers ISSR	2/2	100 %	REFS

FIGURE 11 : SSR MARKERS FOR A CULTIVAR IN OLEA.

SSR MARKERS FOR CULTIVAR LUCQUES

DCA 3	243	253
DCA 5	198	208
DCA 7	167	167
DCA 9	162	184
DCA 13	122	140
DCA 14	181	191
DCA 15	246	246
DCA 16	126	174
DCA 17	143	183
DCA 18	171	177
UDO 043	208	216
GAPU71B	127	130
GAPU101	201	201
GAPU103	177	190
EMO 90	188	188

National Clonal Germplasm repository for Tree fruits and nuts

This collection of *ex situ* vegetal material includes 350 worldwide *Olea europaea* accessions. They are conserved in Davis, California (USA) by the United States Department of Agriculture, Agricultural Research Service. The mission of this repository is to "*collect, preserve, evaluate, and distribute the genetic resources of the crops assigned to [it] as part of the US National Genetic Resources Program. These resources are preserved […] to ensure that these species will be available for future generations and to support research efforts in variety development and other areas of plant research*."

The web page of this department is: https://www.ars.usda.gov/pacific-west-area/davis-ca/natl-clonal-germplasm-rep-tree-fruit-nut-crops-grapes/. The collection can be accessed and searched on a web portal (https://npgsweb.ars-grin.gov/gringlobal/search.aspx) gathering information on other plants as well. DNA molecular markers (microsatellite markers) are detailed in a web-based and searchable repository (**Figure 12**).

FIGURE 12: SCREENSHOT OF THE SEARCH FORM FOR FINDING INFORMATION ON THE "NATIONAL CLONAL GERM PLASM REPOSITORY FOR TREE FRUITS AND NUTS".

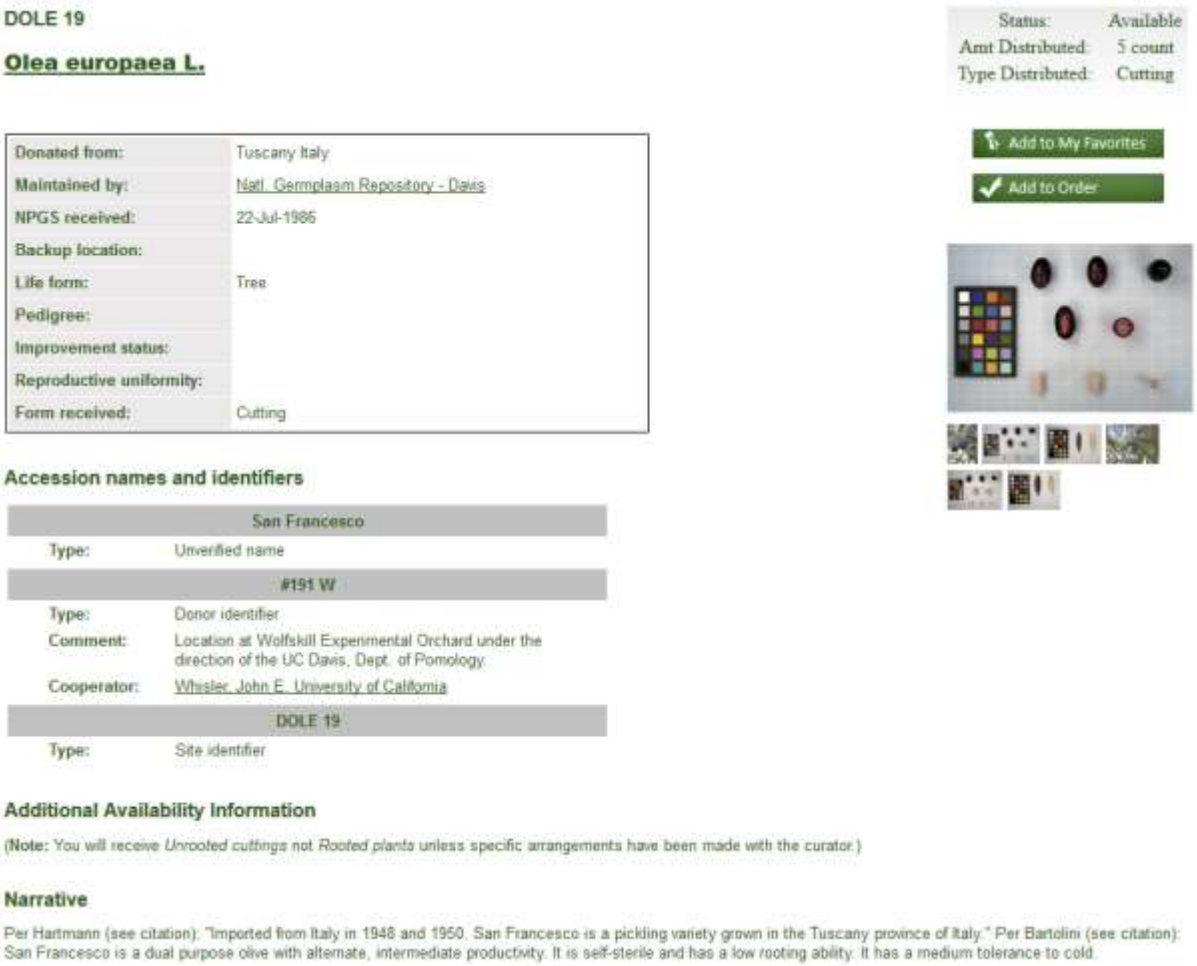
Information in this database refers to accessions: date of entry, its location, its history and information for ordering a sample. It also shows observations and molecular markers, especially microsatellite markers (please refer to the paragraph Genetic databases below) (**Figure 13**). A few pictures of the tree, fruit and leaves are also shown.

Six conspecific taxa are recorded (**Figure 14**); however little information on cultivars and taxonomy is included:

- *Olea europaea subsp. cerasiformis (no accession)*
- *Olea europaea subsp. cuspidata (31 accessions)*
- *Olea europaea subsp. europaea (4 accessions)*
- *Olea europaea subsp. guanchica (no accession)*
- *Olea europaea subsp. laperrinei (no accession)*
- *Olea europaea subsp. maroccana (no accession)*

A record shows information on common names, economic importance, distributional range, references, other web resources and images.

FIGURE 13: SCREENSHOT OF PLANT RECORD IN THE "NATIONAL CLONAL GERM PLASM REPOSITORY FOR TREE FRUITS AND NUTS".



DOLE 19

Olea europaea L.

Status:	Available
Amt Distributed:	5 count
Type Distributed:	Cutting

Add to My Favorites

Add to Order

Donated from:	Tuscany Italy
Maintained by:	Natl. Germplasm Repository - Davis
NPGS received:	22-Jul-1986
Backup location:	
Life form:	Tree
Pedigree:	
Improvement status:	
Reproductive uniformity:	
Form received:	Cutting

Accession names and identifiers

San Francesco	
Type:	Unverified name
#191 W	
Type:	Donor identifier
Comment:	Location at Wolfskill Experimental Orchard under the direction of the UC Davis, Dept. of Pomology
Cooperator:	Whisler, John E. University of California
DOLE 19	
Type:	Site identifier

Additional Availability Information

(**Note:** You will receive *Unrooted cuttings* not *Rooted plants* unless specific arrangements have been made with the curator.)

Narrative

Per Hartmann (see citation): "Imported from Italy in 1948 and 1950. San Francesco is a pickling variety grown in the Tuscany province of Italy." Per Bartolini (see citation): San Francesco is a dual purpose olive with alternate, intermediate productivity. It is self-sterile and has a low rooting ability. It has a medium tolerance to cold.

FIGURE 14: SCREENSHOT OF TAXON RECORD IN THE "NATIONAL CLONAL GERM PLASM REPOSITORY FOR TREE FRUITS AND NUTS".

Taxon: *Olea europaea* L.

Genus:	*Olea*
Subgenus:	*Olea*
Section:	*Olea*
Family:	*Oleaceae*
Tribe:	*Oleeae*
Nomen number:	25555
Place of publication:	Sp. pl. 1:8. 1753
Name Verified on:	29-Jan-2004 by ARS Systematic Botanists. **Last Changed:** 29-Jan-2004
Species priority site is:	Natl. Germplasm Repository - Davis (DAV)
Accessions:	350 in National Plant Germplasm System (GoogleMap)

Worldwide Olive Germplasm Bank (WOGB)

Worldwide Olive Germplasm Banks are facilities designed to safeguard olive biodiversity and to support scientific research for the scientific community and the olive-growing industry by providing characterization with microsatellite molecular markers for identifying cultivars and long-term *ex situ* conservation of genetic resources. Unfortunately there is no web access to this bank.

The World Olive Germplasm Bank of Cordoba (WOGBC) was established at the Center for Agricultural, Fishery and Food and Organic Farming Research and Training Institute (IFAPA) in 1970. Supported by the International Olive Council (IOC), it was the first attempt of conservation and management of olive germplasm. The plant material maintained in this collection is representative of all Mediterranean olive-producing countries.

In 2003, a second world olive germplasm bank was established at the experimental orchard of Tessaout, in Marrakech, Morocco. This bank contains olive cultivars from WOGBC, as well as local genetic resources and other collections.

The World Olive Germplasm Bank of Izmir is the third part of the WOGB network. It is located at the Experimental Station of the Olive research Institute. The project started in 2012 and currently around 187 accessions have been incorporated in the collection (**Table 2**).

TABLE 2: CONTENT OF THE THREE SITES OF WOGB.

	Accessions	Countries
Cordoba, Spain	900	25
Marrakech, Morocco	591	> 14
Izmir, Turkey	187	13
Total	**1.678**	**–**

Source: Rugini, E., Baldoni, L., Muleo, R. & Sebastiani, L. The Olive Tree Genome. (Springer, 2016).

CRA-OLI Collection

The largest Italian *ex situ* olive germplasm collection consisting of approximately 616 Italian and non-Italian olive varieties[6], and corresponding to 85% of the total Italian olive germplasm and to more than 18% of the total world olive germplasm[7], is maintained at the Consiglio per la Ricerca e sperimentazione per l'Agricoltura, Centro di Ricerca per l'Olivicoltura e l'Industria Olearia (CRA-OLI, Agricultural Research Council-Olive Growing and Oil Industry Research Centre) in Italy.

A very comprehensive, open access monograph describing this collection has been published in 2012[8] (**Figure 15**). Morphological characterization (tree, leaf, inflorescence, fruit and pit), biochemical characters (fatty acid composition and results of the organoleptic assessment) and molecular SSR markers are used to describe the accessions. Over 200 elaiographic cards with colour photos, graphs and tables and with full details relating to the identification of the olive varieties are reported.

[6] http://www.parco3a.org/MC-API/Risorse/StreamRisorsa.aspx?quid=a38a9691-2ea2-4a06-9d5d-693383de0354
[7] Muzzalupo I. et al,. Genetic Biodiversity of Italian Olives (*Olea europaea*) Germplasm Analyzed by SSR Markers. *The Scientific Journal* (**2014**). http://dx.doi.org/10.1155/2014/296590.
[8] Muzzalupo I., Olive Germplasm - Italian Catalogue of Olive Varieties, InTech **(2012**), 432 p. Doi: 10.5772/51719. http://www.intechopen.com/download/pdf/41420.

Additional information about agronomic behaviour of the plants, and the results of the organoleptic assessment, as determined by a panel test, were also recorded.

FIGURE 15: COVER PAGE OF THE BOOK INTRODUCING THE CRA-OLI COLLECTION.

Furthermore, this collection is the ground base of the Certolio database (detailed further in the section Genetic databases).

Istrian Olive Database

The Istrian Olive Database (http://old.iptpo.hr/iod/) funded by Croatia and Slovenia collects morphological and molecular description of 13 Istrian olive germplasm, performed according to International Olive Oil Council standards (**Figure 16**).

Morphological characters of tree (3), leaf (4), inflorescence (2), fruit (11) and stones (11) were measured during several years. Eleven records are available in the base. Pictures are available.

Genetic databases

Molecular techniques are widely used nowadays for precise genetic characterization, ascertaining origin and elucidating the dispersal route. DNA-based markers are particularly useful for the correct identification of varieties, due to their independence of environmental conditions, and several of them have been successfully applied for olive: RAPDs, AFLPs, SCARs, ISSRs, SNPs, SSRs, etc.

FIGURE 16: MORPHOLOGICAL DESCRIPTION OF CULTIVARS IN THE ISTRIAN OLIVE DATABASE (CROATIA & SLOVENIA).

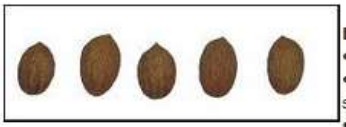
Variety: Rošola
Synonyms: Bjankera

Tree
Vigour: medium
Growth habit: erect
Canopy density: sparse

Leaf
• shape: elliptic-lanceolate
• longitudinal curvature of the blade: flat
• length: medium
• width: medium

Inflorescence
• lenght: medium
• number of flowers: low

Fruit
• shape: ovoid
• symmetry: slightly asymmetric
• position of maximum transverse diameter: central
• apex: rounded
• base: truncated
• nipple: absent
• presence of lenticels: low
• size of lenticels: small
• location of start of colour change: from the base
• colur of full maturity: black
• weight: medium



Endocarp
• shape: ovoid
• symmetry A: symmetric
• symmetry B: symmetric
• position of maximum transverse diameter: central
• apex: rounded
• base: rounded
• surface: rugose
• number of grooves: medium
• distribution of grooves: regular
• termination of the apex: with mucro
• weight: high

Fruit and endocarp weight ratio: 5,95 (83,20:16,80%).
Oil content on dry weight basis:

Root

Microsatellite markers or simple-sequence repeats (SSRs) have proved to be suitable tools for variety characterization and a number of loci have already been developed for olive. They are used for studies of genetic characterization and relationships among individuals because of their co-dominant inheritance, hypervariability, high information content and reproducibility of genotyping results among laboratories.

Several databases are containing information on genetic markers, mainly SSR markers. The most comprehensive ones seem to be the **OLEA SSR-markers database** and the **repOlive** database. The Olive Genetic Diversity Database (OGDD) is designed to enable users to easily retrieve and visualize biologically important information (SSR markers, and olive tree and oil characteristics of about 200 cultivars worldwide). Fragmented information is also available on limited scope in the **National Clonal Germ Plasm repository for Tree fruits and nuts** and in the **Istrian Olive database**. Finally, the **World Olive Germplasm Bank** has been used for many research project whose results, including genetic information, are disseminated in the scientific literature but not gathered in a single location.

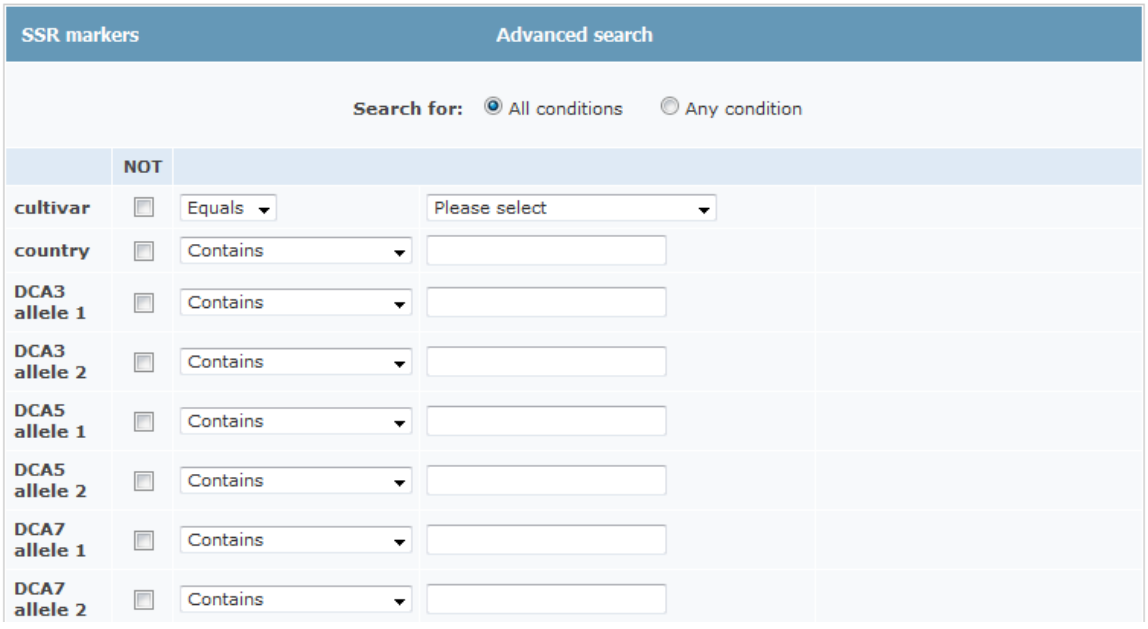
OLEA SSR markers

The OLEA SSR-marker database, part of the OLEA database described in the previous paragraph, contains molecular information, especially microsatellite (SSR) loci of a wide set of olive cultivars.

It is available on the web (http://www.oleadb.it/ssr/ssr_dca_search.php). It gives the possibility to query for cultivars corresponding to a specific data profile or to look for the variety identity when a profile is available. Data refer to both alleles of the 15 following microsatellite (SSR) loci for 80 cultivars (**Figure 17**):

- DCA3, DCA5, DCA7, DCA9, DCA13, DCA14, DCA15, DCA16, DCA17, DCA18, UDO043
- GAPU71B, GAPU101, GAPU103,
- EMO90

FIGURE 17: SCREENSHOT OF SEARCH FORM OF THE OLEA SSR-MARKER DATABASE.



For each locus, allele size of both alleles is provided, expressed in base pairs (**Figure 18**). This information is reused in the Olea database (see previous chapter), but the feature to search by marker is only implemented in the Olea SSR-marker base.

FIGURE 18: RESULTS OF A QUERY IN THE OLEA SSR-MARKER DATABASE.

cultivar	PICHOLINE
country	France
DCA3 allele 1	232
DCA3 allele 2	253
DCA5 allele 1	202
DCA5 allele 2	206
DCA7 allele 1	151
DCA7 allele 2	167
DCA9 allele 1	194
DCA9 allele 2	194
DCA13 allele 1	120
DCA13 allele 2	120
DCA14 allele 1	0
DCA14 allele 2	0
DCA15 allele 1	246
DCA15 allele 2	266
DCA16 allele 1	146
DCA16 allele 2	174
DCA17 allele 1	105
DCA17 allele 2	115
DCA18 allele 1	171
DCA18 allele 2	181
UDO043 allele 1	208
UDO043 allele 2	210
GAPU71B allele 1	144
GAPU71B allele 2	144
GAPU101 allele 1	201
GAPU101 allele 2	207
GAPU103 allele 1	150
GAPU103 allele 2	192
EMO90 allele 1	184
EMO90 allele 2	186

ReprOlive

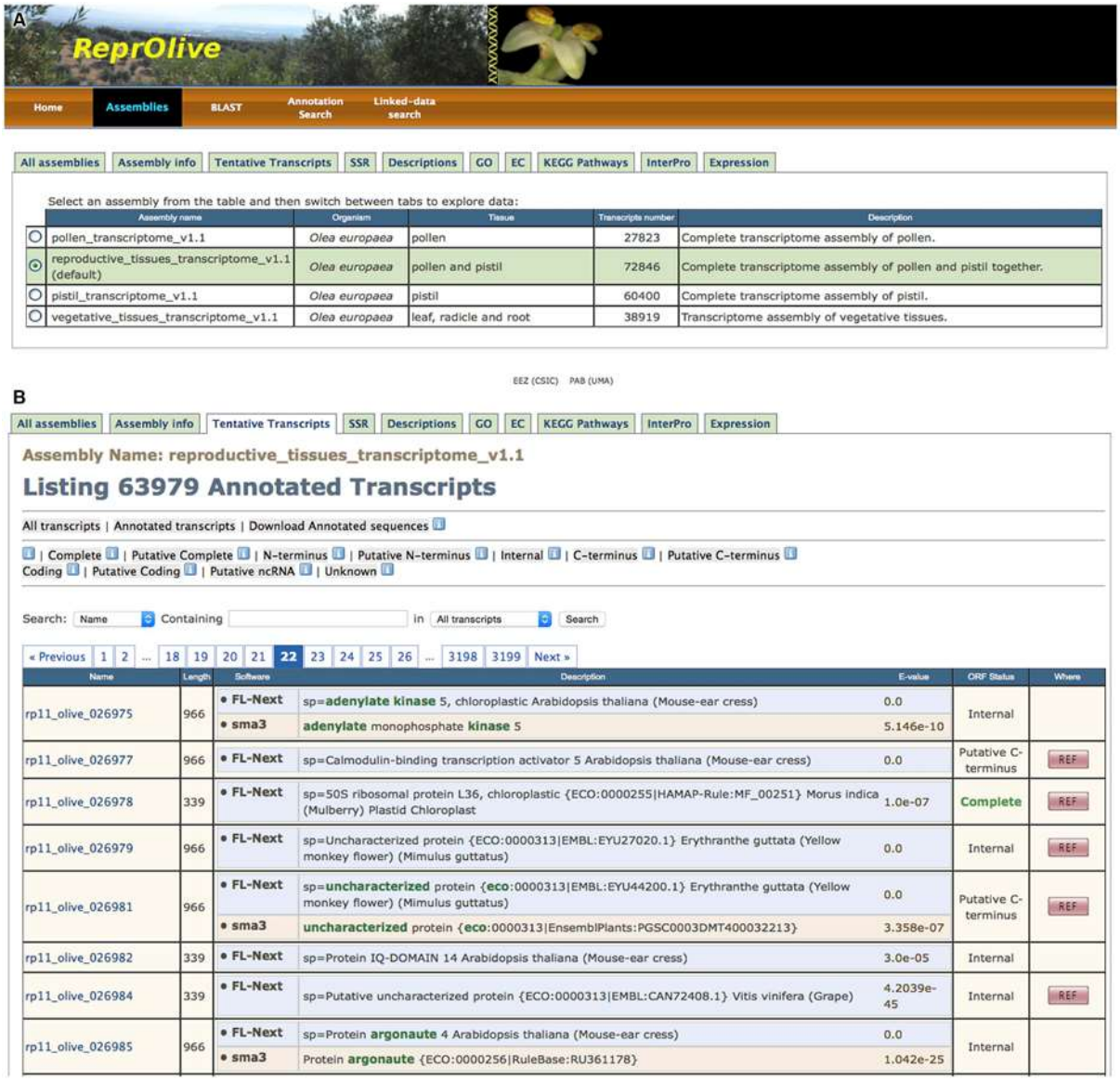
ReprOlive is an olive tree (*Olea europaea L.*) database containing its reproductive transcriptome obtained from pollen and stigma (both together and separately) (**Figure 19**).

Sequences were obtained using Sanger and Next-Generation Sequencing (NGS) technologies (BioProject ID: PRJNA287107), and then assembled and annotated using bioinformatic tools. ReprOlive has been implemented with sequence and annotation retrieval and downloading

mechanisms. Mapping and visualising annotated enzymes to KEGG (Kyoto Encyclopaedia of Genes and Genomes[9]) pathways is also possible.

FIGURE 19: SCREEN CAPTURES PROVIDING A GENERAL OVERVIEW OF REPROLIVE.

(A) "All assemblies" panel showing the four transcriptomes included in the database. **(B)** First page of "Tentative transcript (TTs)" panel, where filtering criteria are accessible and information about each TT is displayed.



Source: Carmona, R. et al. ReprOlive: a database with linked data for the olive tree (Olea europaea L.) reproductive transcriptome. Front. Plant Sci. ***6,*** *(2015).*

[9] http://www.genome.jp/kegg/

It is a free web-based tool (http://reprolive.eez.csic.es) developed from 2,077,309 raw reads to 1,549 Sanger sequences.

ReprOlive runs with the Apache HTTP Server 2 and MySQL 5 database management system in Linux OS. Ruby On Rails 2.3.11 scripts were used to create the user interface on HTML 5 coupled with MySQL.

Certolio

The Certolio database ("CERTificazione della composizione varietale, dell'origine geografica e dell'assenza di prodotti di sintesi negli OLI extravergini di Oliva") gathers genetic information on about 500 olive germplasms from different Italian regions and Mediteranean Basin countries.

It is a web-based tool (http://www.certolio.org/database-varietale/) developed by the CRA-OLI, Agricultural Research Council-Olive Growing and Oil Industry Research Centre, Consiglio nazionale per la ricerca (CNR) and l'Università della Calabria (UNICAL).

Genetic data is displayed by cultivar. It is possible to search for them by country, Italian region and cultivar. A free text search in the whole database is also possible (**Figure 20**).

FIGURE 20: SCREENSHOT OF THE SEARCH FORM OF THE CERTOLIO DATABASE.

This database shows information on the different SSR markers for the cultivars (**Figure** 21).

FIGURE 21: RESULTS FROM A CULTIVAR SEARCH IN THE CERTOLIO DATABASE.

Cultivar	Regione	Nazione	Gapu 59	Gapu 71a	Gapu 71b	Gapu 103a	UDO 001	UDO 003	UDO 12	UDO 028	UDO 039
Abunara	Sicilia	ITALIA	208-212	210-210	124-144	159-170	144-144	143-143	177-177	182-182	108-108
Agristigna	Calabria	ITALIA	208-208	210-210	124-144	170-184	144-144	143-143	166-177	143-205	200-200
Aitana	Sicilia	ITALIA	208-212	210-210	124-144	150-184	144-144	143-143	166-193	182-182	108-108
Albatro	Toscana	ITALIA	208-222	214-214	124-144	159-170	144-144	150-150	177-177	143-182	205-205
Albra	Toscana	ITALIA	212-212	214-214	126-144	159-159	150-150	143-143	164-164	154-182	164-205

Olive Genetic Diversity Database (OGDD)

Olive Genetic Diversity Database (OGDD) (http://www.bioinfo-cbs.org/ogdd/) is a genetic, morphologic and chemical database of worldwide olive tree and oil. These data were collected from the scientific literature and other public resources.

Currently, OGDD is designed to enable users to retrieve and visualize biological information (SSR markers and olive tree and oil characteristics of about 200 cultivars worldwide) using a set of query interfaces and analysis tools (**Figure** 22).

The genetic profile of an olive variety is composed by 10 to 37 markers and each marker has between 2 to 5 alleles, but only 2 alleles are reported. Each variety has a range of additional data such as country, region, acidity, taste, synonym, references, production rates, four photos (tree, leaf, fruit and kernel) and a matching score calculated in order to identify each new genetic profile. From the genetic profiles of varieties presented in the database, the user can identify the origin of the genetic profile submitted (**Figure 23** and **Figure 24**).

The database can be accessed through a web service. The web site is implemented in java, JavaScript, PHP, HTML and Apache. According to the authors, the structure of the database is shown in **Figure 25**.

FIGURE 22: SEARCH FORM IN THE OLIVE GENETIC DIVERSITY DATABASE (OGDD).

(A) First step: marker type (only the SSR section is available). **(B)** Second step: select the markers. (**C**) Third step: enter the DNA profile.

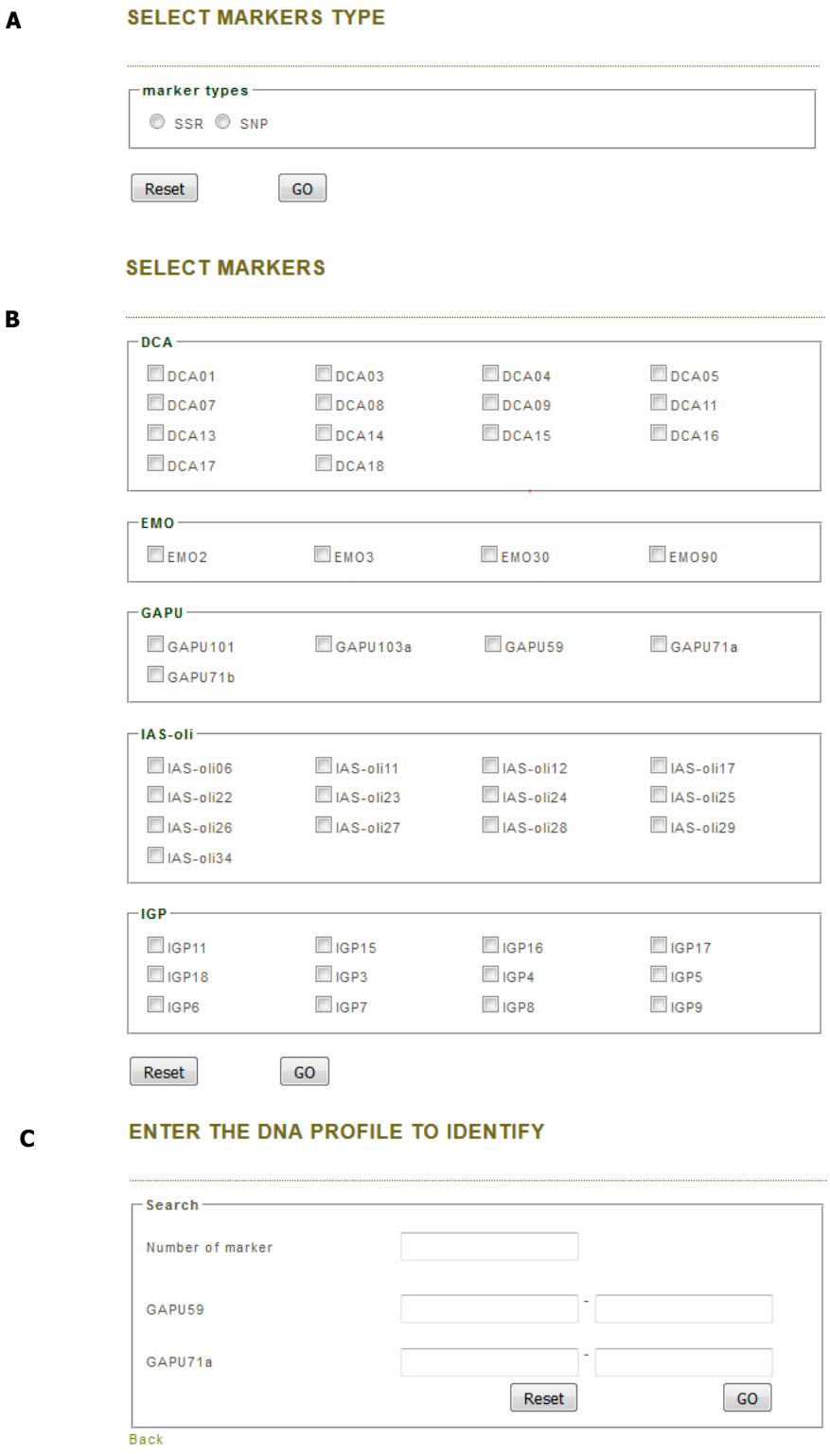


FIGURE 23: RESULTS OF A QUERY ON A GENETIC PROFILE.

FIGURE 24: INFORMATION ON A CULTIVAR IN THE OLIVE GENETIC DIVERSITY DATABASE (OGDD).

ACCESSION NAME Chetoui

Country	Tunisia
Region	Chott Meriem, Borg cedria, Siliana (mohsen limem), Sfax, Tunis, Nabeul
Synonymy	Beldi, Chaibi, Tounsia, Zaiati
Purspose	dual purpose

AGRONOMIC DATA

Pollinization	Self-compatible
Oil content / Fruit %	medium

POMOLOGICAL DATA

Fresh Fruit Weight [g]	2.4

PHYSICO-CHEMICAL DATA

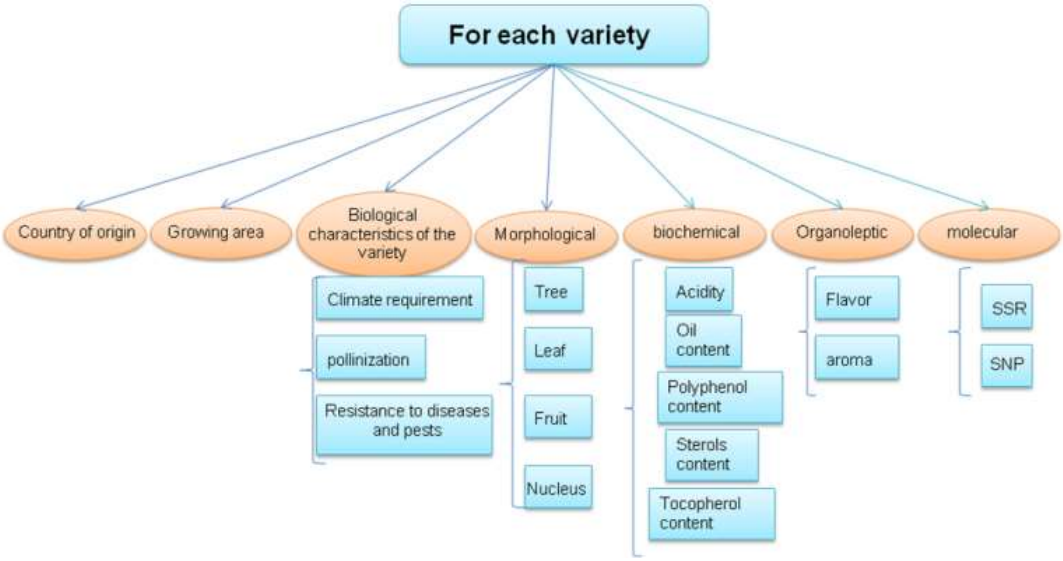
Acidity	0.22
Acidic composition	
Stearic acid %	2.28
Oleic acid %	66.50
Linoleic acid %	17.46
Linolenic acid %	0.64
AGS %	14.66
AGI %	85.50
AGMI %	67.52
AGPI %	17.98
Minor composants	
Polyphenols [mg/kg of oil]	323.21
Sterols [mg/kg]	59.51
Chlorophilles [ppm]	1.76
Carotenes [ppm]	3.79
Tocopherols [mg/kg]	-
Squalene %	-
Reference	Khlif et al. (2001)

MORPHOLOGICAL DATA

General shape of the olive tree | Leaf | Fruit | Nucleus

Image not available | Image not available | Image not available

FIGURE 25: STRUCTURE OF THE OLIVE GENETIC DIVERSITY DATABASE (OGDD).



Source: Ben Ayed et al.*, OGDD (Olive Genetic Diversity Database): a microsatellite markers' genotypes database of worldwide olive trees for cultivar identification and virgin olive oil traceability. Database (Oxford)* ***2016.***

National Clonal Germ Plasm repository for Tree fruits and nuts

This collection of *ex situ* vegetal material is described in more details in the paragraph "Germplasm databases". Apart from the taxonomic information, this database also includes values for SSR markers of the accessions (**Figure 26**). It can be accessed after a search for a cultivar, but SSR markers cannot be searched directly.

FIGURE 26: EXAMPLE OF SSR MARKERS STORED IN THE NATIONAL CLONAL GERM PLASM REPOSITORY FOR TREE FRUITS AND NUTS.

Molecular Data:

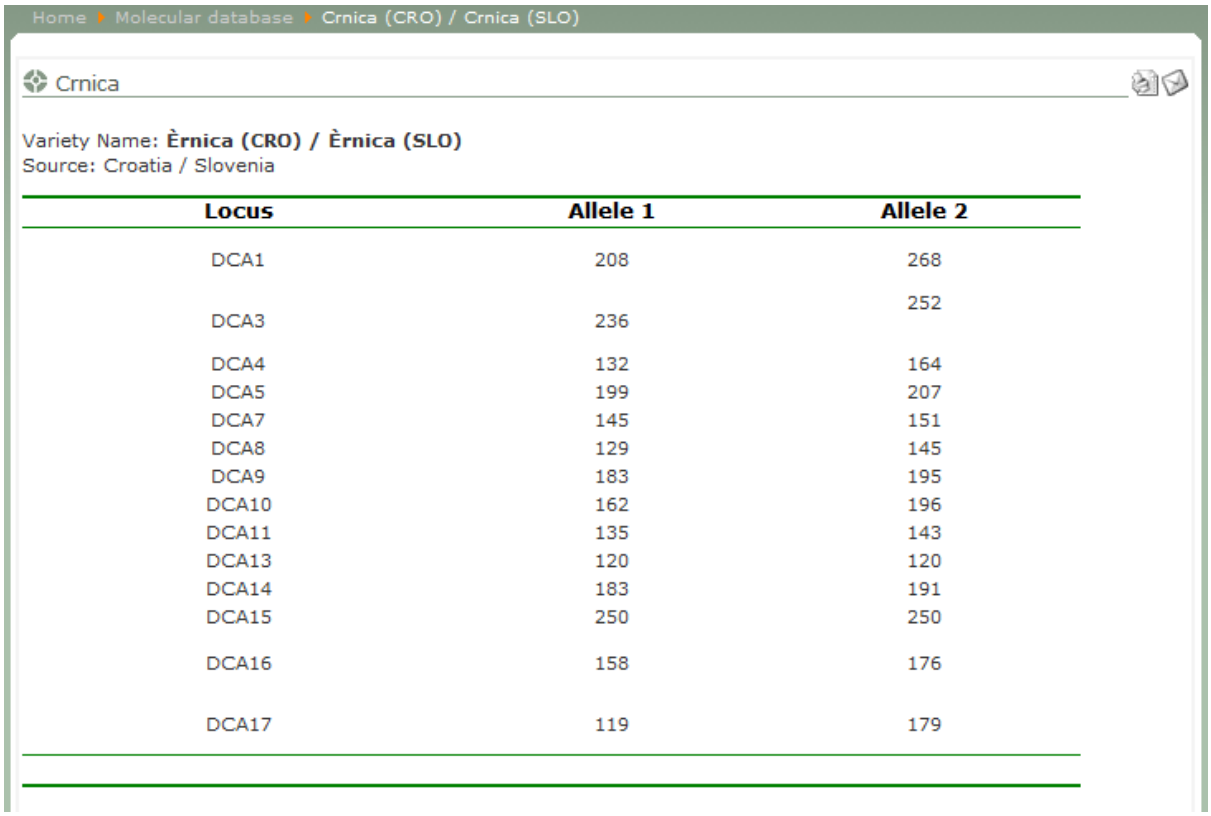
Poly Type	Marker	Value	Evaluation	Study Type	Inventory ID
MICROSATELLITE	EM03	207 209	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	EM030	187 187	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	EM088	184 184	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	EM090	184 190	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	GAPU89	158 201	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	IAS-OLI16	150 164	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	IAS-POE12A	114 114	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	UDO99-011	113 119	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	UDO99-019	129 165	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	UDO99-028	149 149	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	UDO99-042	140 146	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	SSROEUA-DCA11	135 135	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	SSROEUA-DCA3	242 248	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	SSROEUA-DCA8	134 136	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL
MICROSATELLITE	IAS-POE12B	120 123	OLIVE.SSR.DAVIS.2009		DOLE 19 0000A PL

Export Genotype Data to Excel

Istrian Olive Database

The Istrian Olive Database has already been introduced in the paragraph "Germplasm databases". The SSR marker part of the database is only filled for 5 out of the 13 Istrian cultivars: information on both alleles of 14 loci is given (**Figure 32**).

FIGURE 27: EXAMPLE OF SSR MARKERS STORED IN THE ISTRIAN OLIVE DATABASE.



Locus	Allele 1	Allele 2
DCA1	208	268
DCA3	236	252
DCA4	132	164
DCA5	199	207
DCA7	145	151
DCA8	129	145
DCA9	183	195
DCA10	162	196
DCA11	135	143
DCA13	120	120
DCA14	183	191
DCA15	250	250
DCA16	158	176
DCA17	119	179

WOGB

The World Olive Germplasm Bank, containing over 1,600 accessions from more than 25 countries, is the ground material for many scientific studies on molecular markers. Although there is no single database where all the markers were stored, information on these markers is accessible in the scientific literature, for instance in the following publications:

- Haouane, H. *et al.* 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 (2011).
- Belaj, A. *et al.* Developing a core collection of olive (*Olea europaea* L.) based on molecular markers (DArTs, SSRs, SNPs) and agronomic traits. *Tree Genetics & Genomes* **8,** 365–378 (2012).
- Trujillo, I. *et al.* Identification of the Worldwide Olive Germplasm Bank of Córdoba (Spain) using SSR and morphological markers. *Tree Genetics & Genomes* **10,** 141–155 (2014).
- Kaya, H. B. *et al.* SNP Discovery by Illumina-Based Transcriptome Sequencing of the Olive and the Genetic Characterization of Turkish Olive Genotypes Revealed by AFLP, SSR and SNP Markers. *PLOS ONE* **8,** e73674 (2013).

Australian DNA Fingerprints to Identify Olive Cultivars

The last identified database containing DNA molecular marker information on olive tree is a database built by the University of Adelaide (Australia)[10],[11] but apparently without public web access. It gathers DNA fingerprints produced from leaves of numerous olive accessions. This database is used to compare the DNA fingerprints obtained from leaves of trees by growers as well as to determine the level of genetic diversity between both commercial and feral cultivars.

Composition databases

Oli monovarietali italiani

The database **Oli monovarietali italiani** (http://www.olimonovarietali.it/) is the Italian national database of Monovarietal Extra Virgin Olive Oils (**Figure 28**). It contains sensory characteristics, fatty acid composition and content in total polyphenols of Italian virgin olive oils. A total of 2,661 olive oils have been analysed from 166 varieties (December 2016) monovarietal virgin olive oils from Italy, collected during 11 editions from 2006 to 2016 and divided for variety, crop year and geographical origin (regional).

This web-based database is free and no registration is needed.

FIGURE 28: SCREENSHOT OF THE OLI MONOVARIETALI ITALIANI DATABASE HOME PAGE.

[10] Guerin et al. (2002). The development of a genetic database to identify olive cultivars. J. AMER. SOC. HORT. SCI. **127**(6):977–983.
[11] Sweeney S. (2005). National Olive Variety Assessment (NOVA): Stage 2. A report for the Rural Industries Research and Development Corporation. Australian Government. RIRDC Publication N° 05/155; 86 pp.

There is no search function, but the user has several ways to access data with list (**Figure 34**):

- By olive variety.
- By Italian region.
- By sensory profile.

The last option is to see the list of six sensory profiles and to select the desired variety of olive oils.

FIGURE 29 : THE DIFFERENT WAYS TO VIEW DATA IN THE OLI MONOVARIETALI ITALIANI DATABASE.

Whatever the way to select the variety, once it is selected, the user has access to the sensory profile of the variety (**Figure 30**) and the chemical composition in fatty acids (**Figure 31**).

FIGURE 30 : EXAMPLES OF SENSORY PROFILES IN THE OLI MONOVARIETALI ITALIANI DATABASE.

(A) Mean profile. **(B)** Mean profile with confidence limits (95%).

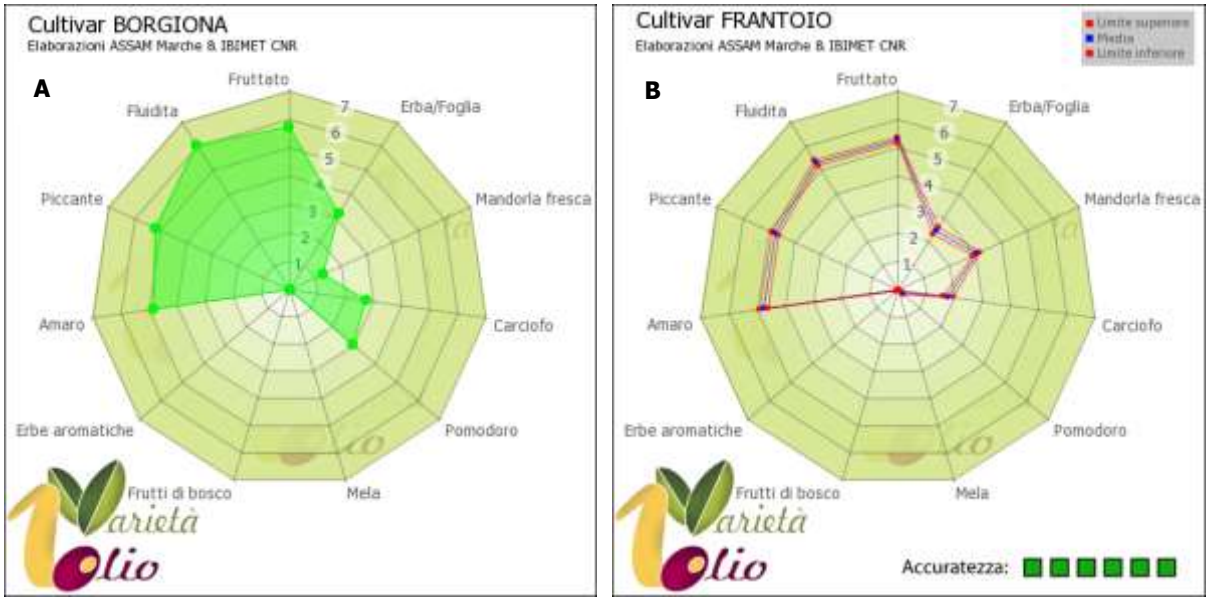


FIGURE 31 : EXAMPLES OF COMPOSITION DATA IN THE OLI MONOVARIETALI ITALIANI DATABASE.

Statistiche descrittive della composizione acidica (n=2)

	Media	Min	Max	St.dev.
Acido eicosenoico	0.27	0.26	0.27	0.01
Acido eicosanoico	0.39	0.36	0.42	0.03
Acido eptadecenoico	0.07	0.07	0.07	0.00
Acido eptadecanoico	0.03	0.01	0.05	0.02
Acido linoleico	6.44	6.44	6.45	0.00
Acido linolenico	0.77	0.73	0.80	0.03
Acido oleico	75.26	73.79	76.74	1.47
Acido palmitico	13.59	12.57	14.60	1.02
Acido palmitoleico	0.78	0.70	0.86	0.08
Acido stearico	2.31	1.87	2.74	0.44
Polifenoli	634.00	589.00	679.00	45.00

Italian National Database of PDO/PGI Extra Virgin Olive Oils

In 2016, this database was maintaining data on 2.330 PDO extra virgin oils from Italy[12]. Olive oils were characterised by IRMS ($^{13}C/^{12}C$, $^{18}O/^{16}O$ and 2H/1H), by ^{1}H NMR (metabolomics approach) as well as acidity values, UV spectrophotometric indices and fatty acid composition. This database is has no web access. It is maintained by the Ministero delle Politiche Agricole, Alimentari e Forestali (MIPAAF).

Sistema Informativo Agricolo Nazionale (SIAN) – Sistema Informativo ICQRF

This database, hosted, maintained and updated by the Italian Ministry of Agricultural, Food and Forestry Policies, has several features:

- Register of olives and olive oils producers and companies;
- Data of ICQRF control activities on olives and olive oils activities;
- Register of samples submitted to chemical and organoleptic analysis;
- Analytical and organoleptic data on olive oils according to Regulation (EEC) No 2568/91 art. 8.2 and the Commission implementing regulation (EU) No 1348/2013; certificates of olive oils analysis.

Access is restricted to Italian citizens through registration with ID cards and password (**Figure 32**).

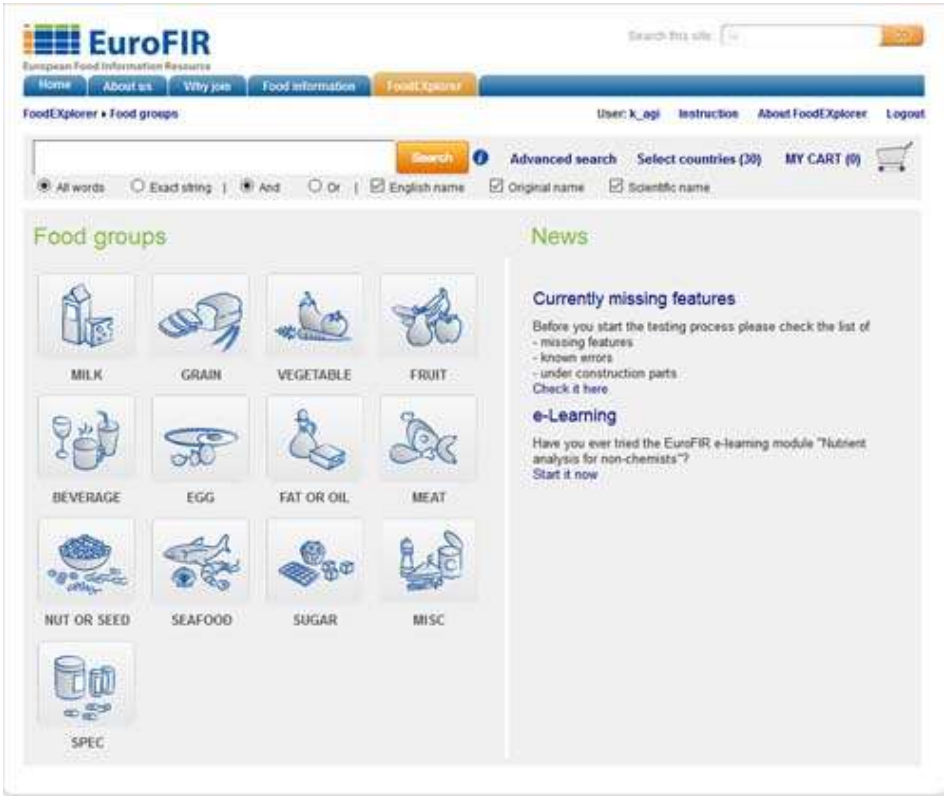
FoodEXplorer by EuroFIR

European Food Information resources EuroFIR's purpose (www.eurofir.org) is to publish and exploit food composition information, and promote international cooperation and harmonisation of standards to improve data quality, storage and access. EuroFIR draws together available food information globally from 26 compiler organisations in Europe, USA and Canada though the tool named FoodEXplorer (http://www.eurofir.org/food-information/foodexplorer/).

[12] Camin et al. The use of IRMS, ^{1}H NMR and chemical analysis to characterise Italian and imported Tunisian olive oils, Food Chemistry, **2016**, Volume 196, Pages 98-105

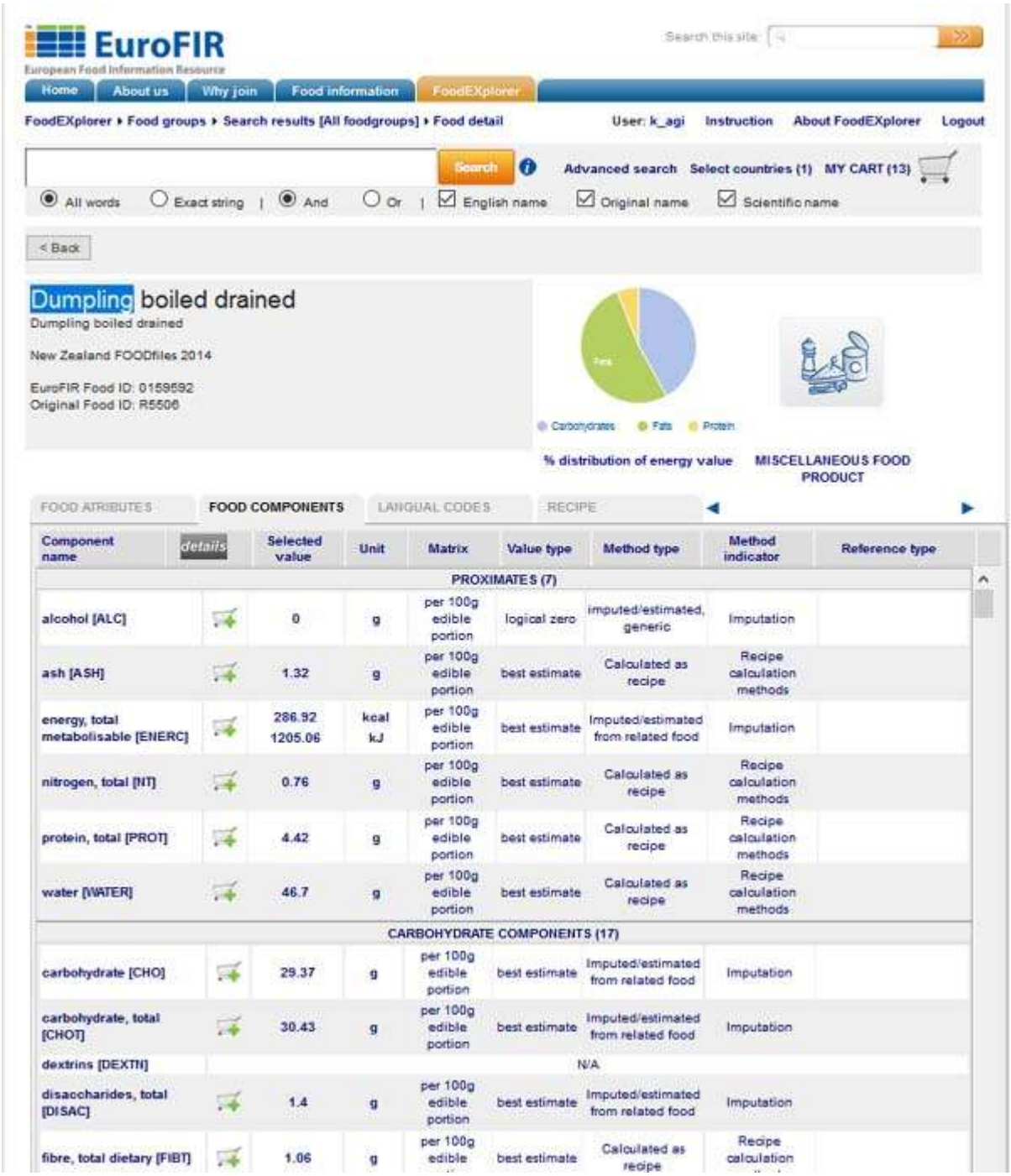
FIGURE 32 : SCREENSHOT OF THE SIAN DATABASE HOME PAGE.

FIGURE 33 : SCREENSHOT OF THE FOODEXPLORER DATABASE HOME PAGE.



Source: Welcome to the FoodEXplorer
http://www.eurofir.org/foodexplorer/instructionfoodexplorer.html

FIGURE 34 : DETAIL FOOD CHEMICAL COMPONENT LIST IN THE FOODEXPLORER DATABASE.



Component name	details	Selected value	Unit	Matrix	Value type	Method type	Method indicator	Reference type
PROXIMATES (7)								
alcohol [ALC]		0	g	per 100g edible portion	logical zero	imputed/estimated, generic	Imputation	
ash [ASH]		1.32	g	per 100g edible portion	best estimate	Calculated as recipe	Recipe calculation methods	
energy, total metabolisable [ENERC]		286.92 1205.06	kcal kJ	per 100g edible portion	best estimate	Imputed/estimated from related food	Imputation	
nitrogen, total [NT]		0.76	g	per 100g edible portion	best estimate	Calculated as recipe	Recipe calculation methods	
protein, total [PROT]		4.42	g	per 100g edible portion	best estimate	Calculated as recipe	Recipe calculation methods	
water [WATER]		46.7	g	per 100g edible portion	best estimate	Calculated as recipe	Recipe calculation methods	
CARBOHYDRATE COMPONENTS (17)								
carbohydrate [CHO]		29.37	g	per 100g edible portion	best estimate	Imputed/estimated from related food	Imputation	
carbohydrate, total [CHOT]		30.43	g	per 100g edible portion	best estimate	Imputed/estimated from related food	Imputation	
dextrins [DEXTN]		N/A						
disaccharides, total [DISAC]		1.4	g	per 100g edible portion	best estimate	Imputed/estimated from related food	Imputation	
fibre, total dietary [FIBT]		1.06	g	per 100g edible	best estimate	Calculated as recipe	Recipe calculation	

Users have access to a wide range of European data, foods and nutrients through harmonized data description and associated nutrient value information. This database is not dedicated to olive oils, but contains data for a various range of foods and food ingredients.

The search facility includes options to search the food composition databases (FCDB), based on several food attributes:

- Original, English or scientific food name / or part of a food name.
- Food groups.
- Lingual thesauri facets (food groups and subgroups, food source, cooking method, treatment applied, preservation, method, packaging medium, geographical regions).
- Chemical food components, with value intervals, units, value types, method types, method indicator, reference type and year of publication.

Search results from different datasets can be compared and also downloaded as xls spreadsheets or xml files in FDTP standards (Food Data Transport Package).

To get access to FoodEXplorer, it is necessary to be member of EuroFIR. This amounts in 2017 to:

- 500 – 1,000 € for non-commercial organisations.
- 2.000 – 5,000 € for commercial organisations.
- 500 € for SMEs.

FATG-DB04

A database of fatty acid & triacylglycerol composition has been built in the 2000's by French researchers from the Olive Tree Technical center (CTO) and the French Olive Professional Association (AFIDOL). It has been updated several times (from DB01 in 2005 to DB04) and included more than 3500 samples for which at least one of the following three criteria is known: variety, designation of origin and producing country[13]. However, it seems that this database is not an online tool.

The authors developed a graphical representation of the fatty acid and triacylglycerol composition of samples by morphograms and of groups (varieties, PDOs, countries) by morphotypes enables swift verification of sample compliance with origin[14]. The databases that help to construct the morphotypes can be amplified each production season in order to incorporate the distinctive features of each season.

[13] Ollivier, D. *et al.* (2014), Creation of a database of the fatty acid and triacylglycerol composition of virgin olive oils produced from 34 French varieties, eight French designations of origin and two foreign varieties grown in France (Part I). Olivae (119): 36-48.
[14] Pinatel, C. *et al.* (2014), New approach to the determination of the origin of olive oils: morphograms and morphotypes (Part II). Olivae (119): 49-65.

Open-access databases and data exchange

Recently there is an emergence of global open-access databases and data exchange efforts between them. In this paragraph, we will describe the foundations and obstacles that enable or prevent the data sharing and re-analysis of this data. Meta-analysis consists of a set of statistical techniques to combine results from several studies. This may reveals insights that could not have been deduced from a single or only a few datasets but of course also poses questions about reproducibility and comparability caused by different experimental designs. Increasingly large, heterogeneous, and complex datasets require extra effort for storing, exchanging, and making sense of data. Initiatives to develop these tools and standards are driven by a range of international collaborations, government initiatives, institutions, and local communities.

Indeed, learned societies, funders, some publishers and, in principle, a good portion of the scientific community agree on the importance of data sharing for the advancement of science. This is exemplified by the guidelines related to open access to data and FAIR data management supported by the European Research Council under Horizon 2020[15,16,17]. Of course, there is a need to balance openness and protection of scientific information, commercialisation and Intellectual Property Rights (IPR), privacy concerns, security as well as data management and preservation questions.

"*Good data management is not a goal in itself, but rather is the key leading to knowledge discovery and innovation and to subsequent data and knowledge integration and reuse by the community after the data publication process*". This quote is taken from a recently published comment on scientific data management and stewardship which advocates a set of four main principles – FAIR: Findability, Accessibility, Interoperability, and Reusability – to improve long term use of collected data[18]. These guidelines were compiled by an international group of stakeholders from academia, industry, funding agencies and publishers and demonstrate how important good data management is to the scientific community. The principles are "high-level"; i.e. they are not linked to any specific technology or standard and are designed to precede implementation.

An example from the Life Sciences area where the FAIR principles are followed is the open source metadata tracking tool kit provided by ISA (Investigation/Study/Assay)[19]. The purpose of this set of tools is to help the researcher to describe a particular experiment as completely as possible so that it can be reproduced, and this includes a full description of the experimental metadata (i.e. sample characteristics, the type of technology used, etc.).

The ISA framework is also part of the Coordination of Standards in MetabOlomicS (COSMOS) initiative, an EU-funded project under FP7, which brings together key players of the European metabolomics community in order to develop a robust data infrastructure and exchange standards for metabolomics data and metadata[20]. COSMOS is supporting the use of MetaboLights, a metabolomics database developed by the European Bioinformatics Institute (EMBL-EBI)[21], which itself uses the ISA-

[15] https://erc.europa.eu/sites/default/files/document/file/ERC_Guidelines_Implementation_Open_Access.pdf
[16] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf
[17] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf
[18] Wilkinson, M. D. *et al.* The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data 2016, 3, 160018.
[19] http://isa-tools.org/
[20] Salek, R. M. *et al.* COordination of Standards in MetabOlomicS (COSMOS): facilitating integrated metabolomics data access. Metabolomics 2015, 11, 1587-1597.
[21] http://www.ebi.ac.uk/metabolights/index

Tab format for reporting study metadata and results. The ultimate aim of the COSMOS project is to provide data producers involved in metabolomics experiments with a single point of submission of data. MetaboLights covers metabolite structures and their reference spectra, as well as the biological roles, locations, concentrations and experimental data from metabolic experiments. MetaboLights includes user submission tools, and incorporates *de-facto* standard formats for encoded spectral and chromatographic data, associated information about chemical structures, and metadata for describing assays and studies as a whole. Since the metabolomics approach is also being used in the authentication of food products, it makes sense for analysts involved in this area to consult the COSMOS guidelines and the consortium OLEUM will ensure that an exchange of information is feasible between these two databases. However, so far no study on *Olea europaea* has been deposited in the MetaboLights database.

In order to enable the re-use of data as well as its barrier-free exchange, data and meta-data stored in public repositories such as MetaboLights need to be encoded using community-agreed standards. A first round of standardisation efforts by the Metabolomics Standards Initiative (MSI) led the publication of documents about the Core Information for Metabolomics Reporting [22] . The recommendations of the MSI on which data to report is nowadays backed by a rich set of ontologies and controlled vocabularies which help researcher speak a common language and to avoid naming diversity through different conventions in different laboratories or communities.

This proliferation in content standards and databases creates a barrier for researchers and database maintainers, creating confusion over which standard they should use to format their data, or which database to submit their data to. BioSharing, composed of three registries covering content standards, databases and data policies in the life sciences, aims to map the landscape of community-developed standards and databases, linking between and from them to data policies from funding agencies and journal publishers[23].

In food fingerprinting approaches using non-targeted spectroscopic (infra-red-based techniques) or spectrometric (mass spectrometry based techniques) chemical analyses, multivariate statistical methods are applied to the resulting analytical data in order to extract the information needed to verify a sample's authenticity. Recognizing the importance of these approaches in food authentication[24] have carried out an extensive overview of a number of relevant published studies using NMR, near infrared (NIR), FT-IR the aim of which was to compile best practice guidelines for the reporting of non-targeted fingerprinting results and make recommendations for the validation of multivariate statistical models used in food authentication.

[22] http://www.metabolomics-msi.org/
[23] https://biosharing.org/
[24] Riedl, J., *et al.*. Review of validation and reporting of non-targeted fingerprinting approaches for food authentication. Anal. Chim. Acta 885, 17–32 (2015).

Conclusions

Based on estimates by the FAO Plant Production and Protection Division Olive Germplasm[25], the world's olive germplasm contains more than 2,600 different varieties, with many local varieties and ecotypes contributing to this richness.

The problem of any germplasm classification (including olive) is not only complicated by the richness of its genetic patrimony, but also by the absence of reference standards and by the confusion regarding the cultivar names, with numerous cases of homonymy (one denomination for several genotypes) and synonymy (one genotype with several denominations).

In order to identify an unknown monovarietal virgin olive oil cultivar, several reference databases have been established providing genetic, morphologic and/or chemical data of worldwide olive trees and oils. The olive cultivar identification and olive oil authentication are especially important for protection of certified brands such as Protected Designation of Origin (PDO), Protected Geographical Indication (PGI) and Traditional Speciality Guaranteed (TSG).

It seems that up to now, there is no database centralising the passport data of all the olive accessions distributed in the existing germplasm banks of olive. However, considering the information gathered, it seems that a significant percentage of the olive germplasm is conserved in the European germplasm banks; the two most important ones being the Worldwide Olive Germplasm bank of Cordoba and the CRA-OLI collection, for which elaiographic cards are also available. The goal of such collections is to conserve all cultivars, and particularly the minor ones, to avoid a loss in genetic diversity and to offer an interesting genetic basis for breeding programs. Consequently, in addition to the passport data, morphological and agronomical data are also collected by the curators. Finally, a variety of molecular and chemical descriptors are characterizing the genetic diversity among and within olive trees and olive oils.

Because of its economic, cultural and ecological importance, various DNA markers have been used in the olive to characterize and elucidate homonyms, synonyms and unknown accessions. It is obvious that the major part of the data available is related to DNA extracted from the olive trees and less from the olive oils. Molecular markers often reported in the databases are traditional as the most common one – microsatellites or simple sequence repeats (SSR). Other markers are less frequently reported in the databases as AFLP, RAPD, ISSR, SCAR and SNPs. It seems that the number of cultivars already characterised by molecular markers is still low and again an estimation of this number is very difficult as they are reported in several databases.

Transcriptome of *Olea europea* from tissues such as fruit, mesocarp, seed, leaves, stems, buds, roots, tricome, pollen, pistil and flowers, is available through several publications, but apparently such data are poorly centralised in a database. Transcriptome database queries may help scientists to develop further research and to design strategies to improve both yield and quality.

Concerning the chemical composition of olive oils, all the databases are storing data from conventional chemical analyses; e.g. fatty acids, triglycerides, organoleptic oil values. The Italian National Database of PDO/PGI Extra Virgin Olive Oils of the Ministero delle Politiche Agricole,

[25] Muzzalupo, I., Oli*ve Germplasm – The Olive Cultivation, Table Olive and Olive Oil Industry in Italy*. InTech: Rijeka, Croatia, 2012; p 383

Alimentari e Forestali (MIPAAF, Italy) is also recording data on isotopic measurements as well as metabolomics data. Two databases are archiving data related to Regulation (EEC) No 2568/91 art. 8.2 and the Commission implementing regulation (EU) No 1348/2013 which are the Sistema Informativo Agricolo Nazionale – SIAN (IT) and the FATG-DB04 of the Olive Tree Technical Center (CTO) and the French Olive Professional Association (AFIDOL). It is most likely that other Member States are also archiving such data but so far we were not able to identify them.

No olive database seems to archive raw data (including spectra) from fingerprinting methods like FTIR or NMR despite the existence of several publications of studies demonstrating the potential of such technologies for the authentication of olive oils.

Shared or even full integration of olive databases is a goal to be pursued by all the consortia involved in the promotion of olive oil and its protection of quality. Being able to achieve this challenge will make it easy to synchronise data between applications and is a more convenient means of exchanging data than file transfer.

Outlook

WP5 already started to contact the curators of the reported databases to evaluate its structure (types of recorded data), to inventory in details the available information (its relevance) and the technicalities (possibility/difficulty) in sharing the information, to identify the software used for building the database, and the needs for future development in preparation of the OLEUM Databank on olive oils. This survey will also give an overview on the type of queries and retrieves, the management of access rights, security systems, and Intellectual Property Rights (IPR).

This inventory will be extended to the laboratories recognised by the International Olive Council to perform the chemical testing and/or the sensory analysis[26].

Efforts will also be provided to identify additional national control bodies performing the conventional chemical analyses related to Regulation (EEC) No 2568/91 art. 8.2 checking the conformity of olive oils, as well as to identify the current curators of the previous databases created during European research projects like TRACE and MoniqA.

[26] http://www.internationaloliveoil.org/estaticos/view/226-laboratories-panels

Annex I. Example of personalised e-mail sent to curators

From: MAQUET Alain (JRC-GEEL)

Sent: Monday, February 20, 2017 2:13 PM

To: 'info@oleadb.it'; 'bartolini@ivalsa.cnr.it'

Cc: 'Jean Francois Morin (JeanFrancoisMorin@eurofins.com)'

Subject: FW: OLEUM project: survey on existing database related to olive trees and olive oil

Miss, Mister,

We are participating to the OLEUM project (H2020; see in attachment a flyer) and we are leading the work package 5 (WP5) "OLEUM databank".

More specifically, the objectives of the WP5 "OLEUM Databank" are:

- To build a web access platform to store the information already existing and generated by the OLEUM consortium.
- To gather, query, retrieve and export the information in a standard format.
- To develop a strategy to ensure the maintenance of the OLEUM databank in the long term as well as its availability using a user-friendly interface to authorised bodies through the European Community.

The challenges will be to store large amounts of data, annotate and analyse them from different domains and technical platforms.

WP5 is currently conducting a survey on existing databases on olive germplasm. In parallel, WP5 is also investigating the existing databases storing experimental data on Olive Oils.

By consulting curators we expect to inventory the available information, to evaluate the structure of the databases, the technicalities (possibility/difficulty) in sharing the information and the needs for future development in preparation of the OLEUM Databank on OOs. This survey will also give an overview on which platforms are used, the types of recorded data, the type of queries and retrieves, the management of access rights, security systems, and Intellectual Property Rights (IPR).

In this context, OLEA databank has been mentioned as a potential source of data related to Olive germplasm. Could you please let me know if the information already gathered is updated and reflects properly your database (see the MS Excel sheet in attachment)? We are also interested by knowing under which conditions this database could eventually be shared with the European community involved in the olives and olive oil sector.

Thank you in advance for your consideration and any further support you could provide us.

Best regards,

Alain Maquet

Annex II. List of olive germplasm collections that contributed to the OLEA olivodb in Italy.

Project Oleum - Deliverable D5.1

Annex II. List of olive germplasm collections that contributed to the OLEA olivodb in Italy

Number	Name	Country	Address	Phone	Fax	Email	Web check
1	STATION OLÉICOLE	Algeria	Cap-Djinet (Tizi-Ouzu)				Institut Technique de l'Arboriculture Fruitière et de la Vigne (ITAFV); email: itafv.dg@gmail.com; URL: www.itafv.dz
2	ESTACIÓN EXPERIMENTAL AGROPECUARIA CATAMARCA - INTA	Argentina	Casilla de correo 25 - 4700 Catamarca	+54-833-41323/2819	+54-833-41192		Instituto Nacional de Tecnología Agropecuaria (INTA); E-mail: José Luis Francisco RIEDEL (Director of the Experimental Center of Catamarca). URL: http://inta.gob.ar/
3	COLECCIÓN DE VARIEDADES DE HINTERMEYER	Argentina	La Rioja				x
4	COLECCIÓN VIVERO NACIONAL	Argentina	La Rioja				x
5	ESTACIÓN EXPERIMENTAL DE QUINES	Argentina	San Luis				x
6	MINISTERIO DE AGRICOLTURA DE SAN JUAN	Argentina	San Juan				x
7	ESTACIÓN EXPERIMENTAL AGROPECUARIA JUNIN - INTA	Argentina	Mendoza				paper on Mendoza collection
8	HORTICULTURAL RESEARCH STATION	Australia	Mildura - Victoria				x
9	Riverina College of Advance Education and Yanco - Agricultural Institute (Charles Sturt University)	Australia	Wagga Wagga - New South Wales 2650	+61 02 6933 2547	+61 02 6933 2737	krobards@csu.edu.au	x
10	INSTITUTE OF HORTICULTURE AND SUBTROPICAL PLANTS	Azerbaijan	Baku				x
11	FAZENDA SAIN ANDRÉ	Brazil	Castro - Parana				link to olea
12	OLIVE GARDEN (SHAANXI)	China	Chengdu County				x
13	Raka	China	Yunnan				x
14	NATIONAL COLLECTION (Faculty of Agriculture - Cairo University)	Egypt	Horticulture Research Institute, Giza				x
15	DEPARTMENT OF POMOLOGY (Dr. Y.S. Parmar University of Horticulture and Forestry)	India	Solan, 173230 - Himashal Pradesh	+91 01791 52 326	+91 01792 20225	nsharma.sol@gmail.com	x
16	OLIVE COLLECTION OF KULU	India	Bajaura 175125 (Kulu) - Himashal Pradesh				x
17	DIRECTORATE OF HORTICULTURE	India	Dakrani (Dhera Dun) - Uttar Pradesh				x
18	DIRECTORATE OF HORTICULTURE	India	Jeolikote (Naini Tal) - Uttar Pradesh				x
19	DIRECTORATE OF HORTICULTURE	India	Maitra (Doda) - Jammu & Kashimir				x
20	DIRECTORATE OF HORTICULTURE	India	Panarsa (Mandi) - Himashal Pradesh				x
21	CENTRO AGRICOLO SPERIMENTALE "MONNA GIOVANNELLA" (C.C.I.A.A. di Firenze)	Italy	Via Peruzzi 146; 50011 Antella (Firenze)	+39 055 2795284	+39 055 2795259	eliopiccini @ficom.it	x
22	Sez. COLTIVAZIONI ARBOREE (University of Pisa), Dipartimento di Coltivazione e Difesa delle Specie Legnose	Italy	Via del Borghetto, 80 - 56100 Pisa	+39 050 2216138	+39 050 2216147	rgucci@agr.unipi.it	x
23	OLIVE COLLECTION OF BARI	Italy	Via Amendola 165/a - 70126 Bari	+39 080 5442991	+39 080 5442813	angelo.godini@agr.uniba.it	x
24	OLIVE COLLECTION OF REGIONE EMILIA ROMAGNA	Italy	Via P. Gobetti, 101 - 40129 Bologna	+39 051 6399011	+39 051 6399024	a.rotondi@ibimet.cnr.it (Annalisa Rotondi)	x
25	DIPARTIMENTO DI ORTOFLOROARBORICOLTURA E TECNOLOGIE AGROALIMENTARI - Sez. Arboricoltura (University of Catania)	Italy	Via Valdisavoia, 5 - 95123 Catania	+39-095-354641	+39-095-356322	tribulat@vm.unict.it	x
26	OLIVE COLLECTION OF REGIONE LIGURIA (Villa Pratola, 19037 S. Stefano Di Magra - La Spezia)	Italy	CAAR-Lab.Anal.terreni-Prod.Veg.-Fitopatol.-Loc. Pallodola c/o Mercato Ortofrutticolo 19038 Sarzana	+39 0187 278762	+39 0187 278785	stefano.pini@regione.liguria.it	x
27	DIPARTIMENTO DI SCIENZE AGRARIE, ALIMENTARI E AMBIENTALI (DSA3)(University of Perugia)	Italy	Borgo XX Giugno, 74 - 06121 Perugia	+39–075 5856247	+39–075 5856255	daniela.farinelli@unipg.it	x
28	ISTITUTO DI SCIENZE DELLE PRODUZIONI ALIMENTARI - CNR	Italy	Via dei Mille, 48 - 07100 Sassari	+39-079233466	+39-079232047	mario.agabbio@ispa.cnr.it	x
29	ISTITUTO PER LA VALORIZZAZIONE DEL LEGNO E DELLE SPECIE ARBOREE - CNR (Az. S. Paolina - V. Aurelia, 49 - 58022 Follonica, GR)	Italy	Via Madonna del Piano, 10 - 50019 Sesto Fiorentino (Firenze)	+39-0555225680	+39-0555225656	g.bartolini@ivalsa.cnr.it	x
30	CENTRO DI RICERCA PER L'OLIVICOLTURA E L'INDUSTRIA OLEARIA – CRA (Pescara)	Italy	Viale Petruzzi, 75 - 65013 Città S.Angelo (Pescara)	+39-08595212	+39-085959518	carla.basti@entecra.it; oli.pe@entecra.it	x

Number	Name	Country	Address	Phone	Fax	Email	Web check
31	AZIENDA AGRICOLA SPERIMENTALE DI S. FLORIANO (Via della Pieve, 64 - 37020 S. Floriano - VR) - Servizio Agricoltura - Istituto Sperimentale di Frutticoltura di Verona	Italy	Via S.Maria Antica 1 e Via delle Franceschine 10 - 37100 Verona	+39 0456833016	+39 0456833010	Gino.Bassi@provincia.vr.it	x
32	CENTRO DI RICERCA PER L'OLIVICOLTURA E L'INDUSTRIA OLEARIA - CRA	Italy	C/da Li Rocchi, - 87036 Rende (Cosenza)	+39 098440201/401858	+39-0984402099	istsperolivic@libero.it	x
33	ISTITUTO TECNICO AGRARIO STATALE "D. AZILOTTI" PESCIA	Italy	Via di Ricciano, 5 - 51017 Pescia (PT)	+39 0572 49401	+39-0572-477957	itaspescia@pec.it	x
34	KAGAWA PREFECTURAL AGRICULTURAL EXPERIMENT STATION - Department Shozu Branch (Olive, Ornamental Plants, Field Crops)	Japan	Ikeda Ikeda-cho Shozu-gun 237 – Kagawa 761-8078	+81 879750033	+81 879751021		x
35	KHALIDI AGRICULTURAL STATIONS	Jordan	Khalidi				x
36	STATION CENTRALE DE RECHERCHE SUR L'OLIVIER (I.N.R.A.)	Morocco	B.P. 415, RP, Rabat	+212 774489/775530			x
37	OLIVE WORLD COLLECTION - Instituto Andaluz de Investigación y Formación Agroalimentaria y Pesquera de Andalucía (IFAPA), Centro Alameda del Obispo	Spain	Avda. Menéndez Pídal, s/n Apdo 3092 - 14004 Córdoba	+34 957016000/+34 957293633/+34 957293333	+34957016043/+34957202721	cordoba.ifapa@juntadeandalucia.es	x
38	Melissa	Tunisia	10 Rue 7131; B.P.676; El Manar II - 1080	216-1-880955	215	rauger@thesca.org	x
39	OLIVE RESEARCH CENTER	Turkey	Kemalpasa, Bornova-Izmir			kaya.hulya@gmail.com	x
40	ASSOCIATION DES AMIS DE L'OLIVIER - Confrérie des chevaliers de l'olivier de Vans. Syndicat des oléiculteurs de l'Ardèche Méridionale.	France	St. Sauveur-de-Cruzières - Ardèche				x
41	ARC-FRUIT, VINE AND WINE RESEARCH INSTITUTE	South Africa	Private Bag X5013 - Stellembosch 7599	+27 218093100	+27 218093400	netmanager@infruit.agric.za - carlo@infruit.agric.za	http://www.arc.agric.za/arc-infruitec-nietvoorbij/Pages/ARC-InfrNietv-Homepage.aspx
42	DIRECÇÃO REGIONAL DE AGRICULTURA DO RIBADEJO E OESTE	Portugal	Rua Joaquim Pedro Monteiro, 8 - 2600-164 Vila Franca Xira	+351 263286600	+351 263286646	ds.agri@draro.pt - dv.oli@draro.pt	x
43	NATIONAL CENTER FOR AGRICULTURAL RESEARCH AND TECNOLOGY TRANSFER	Jordan	PO Box 639, Baq'a; 19381 Amman	+962 64726680	+962 64726099/665356519	garyouti@ncartt.gov.jo	x
44	DIPARTIMENTO DI ORTOFLOROFRUTTICOLTURA (University of Florence) - Azienda Montepaldi	Italy	Polo Scientifico, Via delle Idee, 30 - Sesto Fiorentino Fiorentino (Firenze)	+39-0554574028	+39-055-4574017	dofidise@unifi.it - pfiorino@unifi.it	x
45	INRA, UR-GÉNETIQUE ET AMÉLIORATION DES PLANTES BAT 33	France	2, Place Pierre Viala - 34060 Montpellier cedex 1	+33 499612233	+33 467045415	moutier@supagro.inra.fr -	x
46	USDA, ARS, NATL CLONAL GERMPLASM REPOSITORY (Winters, CA) - Department of Pomology, UCD http://www.ars.usda.gov/Main/docs.htm?docid=12870	United States of America	One Shields Avenue - Davis, CA 95616	+1 5307527009 - +1 5307520122	+1 530 752 5974/8502	jenny.smith@ars.usda.gov	http://www.ars.usda.gov/Main/docs.htm?docid=12870
47	COLLECTION ULJCINJSKO POLJE	Montenegro	Ulcinj				x
48	AGRICULTURAL RESEARCH STATION OF CHALKIDIKI	Greece	Khalkidiki				x
49	INSTITUTE OF OLIVE TREE AND SUBTROPICAL PLANTS OF CHANIA - NAGREF	Greece	Agrokipio, 73100 Chania, Crete	+30 28210/283434	+30 28210/293963	imetzis@nagref-cha.gr	http://www.nagref-cha.gr/index.php/ociviculture-en.html?lang=en#objectives
50	IRTA - Centre de Mas Bover www.irta.es	Spain	Crta. Reus-El Morell Km 3.8, E-43120 Constanti (Tarragona)	+34 977328424/+34 977344055	+34 977344055	joan.tous@irta.es	x
51	NATIONAL COLLECTION (Institut Technique de l'Arboriculture Fruitière et de la Vigne - ITAFV)	Algeria	Station Expérimentale de Sidi Aich - (Bejaia)	+213 21 40 03 37	+213 21 400341		x
52	COLLECTION DE KSAR GHERISS (Maknassy-Mezzouna) - Institut National de Recherches en Génie Rural, eaux et Forets	Tunisia	Rue Hedi Karray - CRGR, 2080 Tunis	+216 1717801			
53	AGRICULTURE RESEARCH CENTER	Iran	Gorgân Province				x
54	ROUDBAR OLIVE STATION	Iran	Gillan Province	+98 01368 2148	+98 01368 2078		http://www.tandfonline.com/doi/full/10.1080/14620316.2016.1162029?src=recsys&

Number	Name	Country	Address	Phone	Fax	Email	Web check
55	THE INSTITUTE OF HORTICULTURE, AGRICULTURAL RESEARCH ORGANIZATION - VOLCANI CENTER	Israel	P.O. Box 6 - Bet Dagan 50250	+972 3 9683360 / +972 3 9683405 / +972 3 9683777	+972 3 9669583	lavee@agri.gov.il	x
56	STATION EXPERIMENTALE D'AHL SOUSS Y SIDI BENNOUR - INRA	Morocco	Souss				x
57	STATION EXPERIMENTALE D'EL MAGHREK	Morocco	Doukkala				x
58	CENTRE REGIONAL DE LA RECHERCHE AGRONOMIQUE DE MÉKNÈS – INRA (collection the Ain Taoujdate)	Morocco	Km 9 Route Haj Kaddour Méknès - Méknès	+212 520300/523711	+212 512039	oukabli@inra.org.ma	x
59	INTERNATIONAL COLLECTION OF MARRAKECH Institut National de la Recherche Agronomique de Marrakech – INRA Station Expérimentale de la Menara	Morocco	Bp 533, 40000 Menara - Marrakech	+212 044 446380	+212 044 446380		x
60	ESTAÇÃO NACIONAL FRUTICULTURA, "VIEIRA NATIVIDADE" - DEPARTAMENTO DE OLIVICULTURA	Portugal	Edificio do Trem Auto, Avenida 14 Janeiro - 7350-903 Elvas; CP7350-228 Elvas	+351 268 628 528; +351 268637740	+351 268628529; 268629295	enmp.inia@mail.telepac.pt	x
61	ESTAÇÃO AGRONÓMICA NACIONAL	Portugal	Av. República, Quinta do Marquês - Nova Oeiras 2784-505 Oeiras	+351 214403500/214416011	+351 214403500/214416011	dir.ean@iniap.min-agricultura.pt	x
62	Agricultural Technology Transfer Center (QTTB Vlore)	Albania	Shamogjin, Komuna Novosele, Vlorë	00355 33 404144/145	00355 33 404144/145	dhimiterpanajoti2003@yahoo.com	x
63	AGRIS Sardegna - Azienda di Villasor Loc. Giviamolas, SS 196, Km 14.250	Italy	Strada St. N. 196, Km. 14.250 - 09034 Villasor (Cagliari)	+39 07096441215		psedda@agrisricerca.it	x
64	TAROM OLIVE RESEARCH STATION	Iran		+98	+98		https://encrypted.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&ved=0ahUKEwiiud-uxKjSAhWJnBoKHS-fDLAQFggxMAM&url=http%3A%2F%2Fcbjournal.areo.ir%2Farticle_100455_964ec56fb324f3e32d6400bb8033ad15.pdf&usg=AFQjCNER7J0CFgq1QRVPRJgKYj1YK9ucmQ&sig2=8-24taM0bTEs5W_QCFRqBA
65	OLIVE COLLECTION - MONTENEGRO University of Montenegro - Biotechnical Faculty Podgorica Institute of Subtropical Cultures-BAR	Montenegro	Ul. Bjelisi bb, 85000 Bar	+38269517788	+38230311718	adakalic@yahoo.com	https://encrypted.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwjNu6TGxKjSAhWG7hoKHZhHDakQFggdMAE&url=http%3A%2F%2Fwww.notulaebotanicae.ro%2Findex.php%2Fnbha%2Farticle%2Fdownload%2F10439%2F7949&usg=AFQjCNHOrQuBQsB-7BBffRND5c3UJIVz8g&sig2=YIMUxcODp_0sBomXNcGCmw&bvm=bv.147448319,d.d2s
66	OLIVE COLLECTION	Slovenia	Strunjan				x
67	NATIONAL COLLECTION Boughrara (Sfax) - Institut de l'Olivier	Tunisia	Route de l'Aéroport Km 1,5 - B.P: 1087 - 3000 Sfax	+216 74241240/+216 74241589	+216 74241033		in survey
68	AZIENDA CAMPO CARBOJ - Menfi (ESA)	Italy	Casella postale 9 - Castelvetrano (Trapani)	+39 092446888	+39 092446888		x
69	CHAMBRE DEPARTEMENTALE D'AGRICULTURE DE HAUTE CORSE - Ghisonaccia	France	15, Avenue Jean Zuccarelli - 20200 Bastia (Corse)	+33 495328440	+33 495328449		x
70	COLLECTION BORJ EL AMRI 1 - Institut de l'Olivier (IRESA) Ministère de l'Agriculture	Tunisia	B.P. 208 - Tunis 1082	+216 98816676	Fax +216 71235820	msallem.monji@iresa.agrinet.tn	x
71	COLLECTION BORJ EL AMRI 2 - Institut de l'Olivier (IRESA) Ministère de l'Agriculture	Tunisia	B.P. 208 - Tunis 1082	+216 98816676	+216 71235820	msallem.monji@iresa.agrinet.tn	x
72	COLLECTION MEHRINE - Institut de l'Olivier (IRESA) Ministère de l'Agriculture	Tunisia	B.P. 208 - Tunis 1082	+216 98816676	+216 71235820	msallem.monji@iresa.agrinet.tn	x
73	COLLECTION CHOTT MERIEM - Ecole Supérieure d'Horticulture et d'élevage de Chott-Mariem (Laboratoire d'arboriculture fruitière)	Tunisia	4089 Chott Meriem (Sousse)	+216 3248134	+216 3248459		x
74	COLLECTION INAT 1 - Institut National Agronomique de Tunisie	Tunisia	43 Avenue Charles Nicole - Tunis 1080	+216 71287110/+216 71289431/+216 71892785			x
75	COLLECTION INAT 2 - Institut National Agronomique de Tunisie	Tunisia	43 Avenue Charles Nicole - Tunis 1080	+216 71287110/+216 71289431/+216 71892785			x

Annex II. List of olive germplasm collections that contributed to the OLEA olivodb in Italy

Number	Name	Country	Address	Phone	Fax	Email	Web check
76	COLLECTION BIR CHBIKA - Coopérative centrale des semences et plants sélectionnés	Tunisia	45 Avenue Farhat Hached - Tunis 1000	+216 1336106	+216 1352200/+216 1346612		x
77	COLLECTION CHOTT EL FERIK - Institut des Régions Arides	Tunisia	4119 Médenine	+216 75633005	+216 75633006	Neffati.Mohamed@ira.rnrt.tn	x
78	ZYGHI EXPERIMENTAL STATION - Agricultural Research Institute	Cyprus	1516 Nicosia	+357 2305101	+3579 2316770	sysman@arinet.ari.gov.cy - gregor@arinet.ari.gov.cy	x
79	PLANT SCIENCE, FACULTY OF AGRICULTURE - University of Western Australia	Australia	6009, Nedlands (Western Australia)	+08 93802505	+08 93801140		x
80	ISTITUTO PER I SISTEMI AGRICOLI E FORESTALI DEL MEDITERRANEO – CNR	Italy	Via Madonna Alta 128 - 06128 Perugia	+39 0755014541/511	+39 0755014547	m.mencuccini@isafom.cnr.it	x
81	AGRICULTURE RESEARCH CENTER	Iran	Ahvaz Khozestan Province	+98	+98		http://www.abrii.ac.ir/en/#
82	AGRICULTURE RESEARCH CENTRE - Dezful Research Station Safiabad	Iran	Dezful - Khozestan Province	+98-	+98-		x
83	BISSINGKHEL AND CHITLANG	Nepal	Makwanpur	+977	+977		https://www.oliveoilsource.com/page/olive-varietals
84	KIRTIPUR	Nepal	Katmandu	+977	+977		x
85	KIRTIPUR	Nepal	Katmandu	+977	+977		x
86	MARPHA	Nepal	Marpha	+977	+977		x
87	THAIBA	Nepal	Lalipur	+977	+977		x
88	CENTRE REGIONAL DE HAOUZ PRESAHARA - INRA	Morocco	B.P. 533 Marrakech				x
89	ISTITUTO TECNICO AGRARIO STATALE "P. D'AQUILEIA" - Ministero Pubblica Istruzione	Italy	Via Istituto Agrario 10 - 33043 Cividale del Friuli (Udine)	+39 0432733373			x
90	DIPARTIMENTO DI PRODUZIONE VEGETALE – SEZ. COLTIVAZIONI ARBOREE (University of Milano); Azienda Cavazza - S.Felice del Benaco (BS)	Italy	Via Celoria 2 - 20133 Milano	+39 02503116560	+39 0250316553	daniele.bassi@unimi.it	x
91	AZIENDA AGRICOLA SPERIMENTALE DIMOSTRATIVA "INCORONATA" - ALSIA	Italy	S.S. 401 km 2.1 - 85025 Melfi (Potenza)	+39 097224212	+39 0972237871	azienda.incoronata@alsia.it	x
92	TOKUSAN NO KUDAMONO OLIVE - Association of japan fruits nurseries	Japan	Ideta, Takagi				x
93	CENTRO DI RICERCA PER L'OLIVICOLTURA E L'INDUSTRIA OLEARIA – CRA; Sede distaccata di Spoleto	Italy	Via Nursina, 2 - 06049 Spoleto (Perugia)	+39 074349743		gpannelli@libero.it	x
94	NATIONAL COLLECTION	Australia	University of Adelaide, Roseworty Campus (-34°52'S, 138°69'E), Roseworty - South Australia 5371	+61 08 8303 9673	+61 08 8303 9424	sweeney.susan@saugov.sa.gov.au	x
95	AZIENDA DIMOSTRATIVA ARSIAL - CAMPO COLLEZIONE OLIVI	Italy	02034 Montopoli di Sabina (Rieti)	+39 3384305054		saldean2015@libero.it	x
96	CENTRO DIDATTICO-SPERIMENTALE "P.MARTUCCI" Dipartimento Scienze Agro-Ambientali e Territoriali (University of Bari) (S.P. Valenzano-Casamassima - 70010 Valenzano, BA)	Italy	Via Amendola, 165/a - 70126 Bari	+39 0805442982	cell. 3395921430	salvatore.camposeo@uniba.it	x
97	CENTRO REGIONALE DI PREMOLTIPLICAZIONE "VIVAI CONCA D'ORO" (S.S. 106 km 468,5 - 74019 Palagiano, Taranto) - Centro Ricerca e Sperimentazione in Agricoltura "Basile Caramia"	Italy	Via Costernino, 281 - 70010 Locorotondo (Bari)	+39 0804313071	+39 0804313071	crsa@libero.it	x
98	ISTITUTO TECNICO AGRARIO STATALE "V. LUPARIA" - Ministero Pubblica Istruzione	Italy	Via Luparia 14 - 15030 Rosignano fraz. S.Martino (Alessandria)	+39 0142488151	+39 0142488748	segreteria@luparia.it - giandurando@libero.it	x
99	BANCO DE GERMOPLASMA DE OLIVO - Conselleria de Agricultura, Pesca Y Alimentación; Llíria (Valencia)	Spain	C/ Amadeo de Saboya, 2 - 46010 Valencia	+34 963424500			x
100	UNIVERSITY OF LJUBLJANA	Slovenia	P.O. Box 2995; Jannikarjeva 101 - SI 1111, Ljubljana				x

Annex II. List of olive germplasm collections that contributed to the OLEA olivodb in Italy

Number	Name	Country	Address	Phone	Fax	Email	Web check
101	ISTITUTO PER I SISTEMI AGRICOLI E FORESTALI DEL MEDITERRANEO – CNR; C/o Società Vivai d'Armerina s.r.1. Pergusa (Enna)	Italy	Via Madonna Alta 128 - 06128 Perugia	+39 0755014541/511	+39 0755014547	m.mencuccini@isafom.cnr.it	x
102	NATIONAL COLLECTION - ENA (Département d'Arboriculture/Ecole Nationale d'Agriculture de Meknès)	Morocco	Km 10 Route Haj Kaddour, B.P. S/40 - Meknès, 50001	+212 35300239/40/41	+212 35300237/38	nouazani@hotmail.com ena@enameknes.ac.ma	http://www.enameknes.ac.ma/node/148
103	Lebanese Agricoltural Research Institute - Abdè Station	Lebanon	LARI - Fanar Laboratory; Jdeidt et Metn-BP90-1965				x
104	Agricultural Research Agency of Minas Gerais State (EPAMIG)	Brazil	Maria da Fé, Minas Gerais, Brazil			cancado@epamig.br	x
105	NATIONAL COLLECTION	Syrian Arab Republic	Idleb				x
106	BANCO DE GERMOPLASMA, Campus Azapa de la Facultad de Agronomia	Chile	Universidad de Tarapaca, Campus Azapa, Casilla 6D, Arica				http://www.fca.unl.edu.ar/prodocova/germoplasma.xhtml
107	BINE EXPERIMENTAL STATION	Azerbaijan					x

Annex III. List of existing olive and olive oil databases.

Name	Type of records	Description of records	Link	Nb of records	Main fields	Type of queries and retrieves	Access rights management and security systems
OLEA olivodb	Germplasm	Olive Germplasm	http://www.oleadb.it/olivodb.html	1,607 cultivars 1,841 references	Cultivars synonyms cultivation areas Descriptors : morphological, agronomical, biotic stress, abiotic stress, biochemical markers, molecular markers, reference publications, collections	By name of cultivar By scientific parameters (morphology, stress…) By collection By publication By historical name	Free, no registration
OLEA SSR markers	Germplasm; Genetic	Genetic information on cultivars: cultivars, synonyms, cultivation areas, descriptors.	http://www.oleadb.it/ssr/ssr_dca_search.php	80 cultivars 15 loci, both alleles	Cultivar name Country	By cultivar name By country By allele size There is the possibility to query for cultivars corresponding to a specific data profile or, on the contrary, to search for the variety identity when a profile is available.	Free, no registration
Worldwide Olive Germplasm Bank of Córdoba (WOGBC)	Germplasm; Genetic	Collection of cultivated plants ex situ.	https://www.researchgate.net/publication/289418761_The_Olive_World_Germplasm_Bank_of_Spain	900 accessions (2016)	Not an online DB	-	-
Worldwide Olive Germplasm Bank of Marrakech (Morocco).	Germplasm; Genetic	Collection of cultivated plants ex situ. Not online. 2 nuclear microsatellites (SSRs) and three chloroplast DNA markers	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3247671/	591 accessions (2016) from 15 countries	Not an online DB	-	-
Worldwide Olive Germplasm Bank of Izmir (Turkey)	Germplasm; Genetic	Collection of cultivated plants ex situ.	https://www.oliveoiltimes.com/olive-oil-basics/world/olive-bank-izmir-turkey/25771	187 accessions (2016)	Not an online DB	-	-
CRA-OLI collcection	Germplasm	Collection of cultivated plants ex situ.	http://www.parco3a.org/MC-API/Risorse/StreamRisorsa.aspx?guid=a38a9691-2ea2-4a06-9d5d-693383de0354	616 accessions (562 Italian, 54 other countries)	Not an online DB	-	-
National Clonal Germplasm Repository - Tree Fruit & Nut Crops & Grapes	Germplasm; Genetic	Collection of vegetal material ex situ from worldwide Olea europaea trees. Molecular data are also present	Repository: https://www.ars.usda.gov/pacific-west-area/davis-ca/natl-clonal-germplasm-rep-tree-fruit-nut-crops-grapes/ Search: https://npgsweb.ars-grin.gov/gringlobal/search.aspx	134 germplasm of olives	Cultivar name Description of the tree Molecular Data: microsatellite markers	By taxonomy, country, name…	Free, no registration
Istrian Olive Database	Germplasm; Genetic	Morphological and molecular (SSR) data	http://old.iptpo.hr/iod/index.php?option=com_frontpage&Itemid=1	13 cultivars present in Istria	Fields describing tree, leaf, fruit, stone and root	None. Just the list of cultivars with metadata	Free, no registration
Olive Genetic Diversity Database (OGDB)	Genetic; Composition oil	Six SSR marker families	http://www.bioinfo-cbs.org/ogdd/Methodology.php	200 cultivars worldwide	Country, region, acidity, physico-chemical data, pictures, taste, synonym, references, production rates	By marker type (SSR, SNP), we select the one we sequenced, then we enter the length of the sequence.	Free registration
Australian DNA Fingerprints to Identify Olive Cultivars	Genetic	DNA fingerprints	No web access. See publication	400 accessions	-	-	-
ReprOlive	Genetic	Olive tree (Olea europaea L.) database containing its reproductive transcriptome obtained from pollen and stigma	http://reprolive.eez.csic.es/olivodb/	1,549 Sanger sequences Reproductive transcriptome comprising 72,846 contigs	Annoted sequences with expression data, descriptions, GO terms, InterPro signatures, EC numbers, KEGG pathways, ORFs, SSRs and Tentative transcripts (TTs)	Three different possibilities of search (by sequence, by text strings on annotations, and by Linked Data)	Free, no registration
FATG-DB04	Composition oil	Fatty acid & triglycerides composition; morphogrammes. Not online	No web access. See publication	3.500 samples in 2014	-	-	-

Name	Owner	Country	Analytical dataset	Publications	Contact	Copyright
OLEA olivodb	National Research Council ITALY ?	Italy	No		info@oleadb.it bartolini@ivalsa.cnr.it	no mention on the website (authors claimed it was fully open)
OLEA SSR markers	Istituto per la Valorizzazione del Legno e delle Specie Arboree – CNR	Italy	No		info@oleadb.it	no mention on the website
Worldwide Olive Germplasm Bank of Córdoba (WOGBC)	Centro de Investigación y Formación Agraria (CIFA)	Spain	No	http://rd.springer.com/article/10.1007/s11295-013-0671-3 https://www.researchgate.net/publication/289418761_The_Olive_World_Germplasm_Bank_of_Spain http://link.springer.com/article/10.1007/s00122-002-0981-6 https://books.google.fr/books?id=DgDGDQAAQBAJ&dq=olive+germplasm+izmir&hl=fr&source=gbs_navlinks_s	ucc@uco.es	not online
Worldwide Olive Germplasm Bank of Marrakech (Morocco).	National Institute of Agronomic Research (Marrakech, Morocco).	Morocco	No	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3247671/	khadari@supagro.inra.fr (?) see article authors	not online
Worldwide Olive Germplasm Bank of Izmir (Turkey)	Unknown	Turkey	No	https://fr.slideshare.net/ICARDA/theme-5-day2-theme5-p4lhassane		not online
CRA-OLI collcection	Centro di Ricerca per l'Olivicoltura e l'Industria Olearia (CRA-Oli)	Italy	No	http://www.parco3a.org/MC-API/Risorse/StreamRisorsa.aspx?guid=a38a9691-2ea2-4a06-9d5d-693383de0354	Adolfo Rosati	not online
National Clonal Germplasm Repository - Tree Fruit & Nut Crops & Grapes	University of California	USA	No		Preece, John (530) 752-7009 John.Preece@ars.usda.gov Research Leader	see https://npgsweb.ars-grin.gov/gringlobal/disclaimer.aspx USDA grants to each Recipient of this software non-exclusive, royalty free, world-wide, permission to use, copy, modify, publish, distribute, perform publicly and display publicly this software. Notice of this permission as well as the other paragraphs in this notice shall be included in all copies or modifications of this software.
Istrian Olive Database	. Institute of Agriculture and Tourism (Poreè, Croatia), . Centre for Plant Biotechnology and Breeding, Biotechnical Faculty, University of Ljubljana (Slovenia) . University of Primorska, Science and Research Centre of Koper (Slovenia)	Croatia/Slovenia	No	D. Poljuha, B. Sladonja, E. Šetiæ, A. Milotiæ, D. Bandelj, J. Jakše, B. Javornik, DNA fingerprinting of olive varieties in Istria (Croatia) by microsatellite markers, Scientia Horticulturae (2008), Volume 115, Issue 3, Pages 223-230.	barbara@iptpo.hr jernej.jakse@bf.uni-lj.si	© Istrian olive database 2005 all rights reserved
Olive Genetic Diversity Database (OGDB)	Bioinformatics and Functional Genomics Group (BFGG) of the Centre of Biotechnology of Sfax (CBS)	Tunisia	Yes	https://www.ncbi.nlm.nih.gov/pubmed/26827236 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4733328/	ogdd@bioinfo-cbs.org raydabenayed@yahoo.fr	Copyright © 2017. All rights reserved
Australian DNA Fingerprints to Identify Olive Cultivars	University of Adelaide	Australia	Yes	http://www.floridaolivecouncil.org/FOC/Research_files/Olive_DNA_database.pdf	See article: G. Collins	not online
ReprOlive	Consejo Superior de Investigaciones Científicas (CSIC)	Spain	Yes	R Carmona, A Zafra, P Seoane, AJ Castro, D Guerrero-Fernández, T Castillo-Castillo, A Medina-García, FM Cánovas, JF Aldana-Montes, I Navas-Delgado, JD Alché and MG Claros. ReprOlive: a database with linked data for the olive tree (Olea europaea L.) reproductive transcriptome. Front. Plant Sci., 11 August 2015. http://dx.doi.org/10.3389/fpls.2015.00625	juandedios.alche@eez.csic.es	EEZ (CSIC) PAB (UMA) (?)
FATG-DB04	CTO-AFIDOL (Centre Technique de l'Olivier)	France	Yes	http://afidol.org/commercant/morphogrammes/ http://afidol.org/commercant/triglycerides/	Christian Pinatel - CTO	not online

Name	Type of records	Description of records	Link	Nb of records	Main fields	Type of queries and retrieves	Access rights management and security systems
Oli monovarietali italiani	Composition oil	Italian National Database of Monovarietal Extra Virgin Olive Oils. Sensory characteristics, fatty acid composition and content in total polyphenols of virgin olive oils	http://www.olimonovarietali.it/database/accesso-alla-banca-dati	2661 OO analysed from 166 varieties (December 2016) monovarietal virgin olive oils from Italy, collected during 11 editions from 2006 to 2016 and divided for variety, crop year and geographical origin (regional)	Olive variety: sensory and chemical profiles; Geographical origin: Italian regions	No search function, but several ways to access data with list: by olive variety; By Italian region; By sensory profile.	Free, no registration
Sistema Informativo Agricolo Nazionale (SIAN) - Sistema Informativo ICQRF	Composition oil	Register of olives and olive oils producers and companies; data of ICQRF control activities on olives and olive oils activities; register of samples submitted to chemical and organoleptic analysis; analytical and organoleptic data on olive oils according to EEC Reg. 2568/91; certificates of olive oils analysis	http://www.sian.it/portale-sian/home.jsp	Not available	Companies; Analytical Parameters; Conformity to European and National Regulations; Sanctions. According to EEC Reg. 2568/91 (art. 8) and following amendments, the analytical data reported in this database are transmitted from the Italian Ministry of Agricultural, Food and Forestry Policies to EC every year, by 31st May.	By analytical data; by conformity; by company names etc.	Registration and password for Italian citizens. Management by MIPAAF; ALMAVIVA.
Italian National Database of PDO/PGI Extra Virgin Olive Oils (stable isotope ratios of C, H, O)	Composition oil	IRMS (13C/12C, 18O/16O and 2H/1H), 1H NMR, acidity values, UV spectrophotometric indices (K232, K270, DK) and fatty acid composition	No web access	2.330 (December 2016) PDO extra virgin olive oils from Italy, collected from 2000 to 2016	PDO/PGI denomination; Olive variety; Geographical origin: municipality, province, region	By olive variety; By Italian region; By crop year; By province; By PDO/PGI;	No public access
FoodEXplorer	Composition oil	Food composition database (oil/fat)	http://www.eurofir.org/	> 60,000 foods, 13,000 recipes, and 3500 branded foods (in 2014)	Simultaneous search of 30 standardized and specialized food composition databases (FCDB) from EU member states an, USA and canada	Original, English or scientific food name / or part of a food name Food groups Langual thesauri facets (food groups and subgroups, food source, cooking method, treatment applied, preservation, method, packaging medium, geographical regions) Chemical food components	Membership (500-1000 EUR non-profit organisation)
Certolio	Genetic	Genetic SSR markers for different cultivars in Italy	http://www.certolio.org/database-varietale/	489 varieties of olive trees from 17 Italian countries	Cultivar, country, SSR markers anfd loci.	Selection of a cultivar by country and region	Free, no registration

Name	Owner	Country	Analytical dataset	Publications	Contact	Copyright
Oli monovarietali italiani	ASSAM - Agenzia Servizi Settore Agroalimentare delle Marche (Osimo - AN) Istituto di Biometeorologia - Consiglio Nazionale delle Ricerche (Bologna)	Italy	Yes	Influence of genetic matrix and crop year on chemical and sensory profiles of Italian monovarietal extra-virgin olive oils. By Annalisa Rotondi, Barbara Alfei, Massimiliano Magli and Giorgio Pannelli. J Sci Food Agric 2010; 90: 2641–2648. DOI 10.1002/jsfa.4133. Chapter 8 Italian National Database of Monovarietal Extra Virgin Olive Oils by Annalisa Rotondi, Massimiliano Magli, Lucia Morrone, Barbara Alfei and Giorgio Pannelli http://www.intechopen.com/books/the-mediterranean-genetic-code-grapevine-and-olive/italian-national-database-of-monovarietal-extra-virgin-olive-oils	alfei_barbara@assam.marche.it; m.magli@ibimet.cnr.it	Olimonovarietali.it by ASSAM Marche e CNR-IBIMET is licensed under a Creative Commons Attribuzione-Non commerciale-Non opere derivate 2.5 Italia License.
Sistema Informativo Agricolo Nazionale (SIAN) - Sistema Informativo ICQRF	MIPAAF	Italy	Analytical parameters according to EEC Reg. 2568/91; pesticides data set on organic olives oils	not available	MIPAAF PREF I (OLEUM MS-AB Member)	Copyright © 2009 - SIN S.p.A.
Italian National Database of PDO/PGI Extra Virgin Olive Oils (stable isotope ratios of C, H, O)	Ministero delle Politiche Agricole, Alimentari e Forestali (MIPAAF), ICQRF DG PREF Ufficio PREF V e Laboratorio centrale di Roma, Via Del Fornetto 85, I-00149 Rome, Italy	Italy	Yes	Camin, F.; Pavone, A.; Bontempo, L.; Wehrens, R.; Paolini, M.; Faberi, A.; Marianella, R. M.; Capitani, D.; Vista, S.; Mannina, L., The use of IRMS, 1H NMR and chemical analysis to characterise Italian and imported Tunisian olive oils. Food Chem. 2016, 196, 98-105.	pref4@politicheagricole.it ; federica.camin@fmach.it	Not available
FoodEXplorer	EuroFIR AISBL non-profit Association under Belgian law	Belgium	Yes	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4188244/	pf@eurofir.org secretariat@eurofir.org	see: http://www.eurofir.org/copyrights-and-trademark/ The use of original texts, graphics, images, screen shots and other materials from EuroFIR sources must be approved by EuroFIR. In addition, when using such materials, you must include a copyright notice – either in an adjacent area or as a footnote – to indicate EuroFIR's copyright. The copyright should read as follows: "© <year> EuroFIR. All rights reserved."
Certolio	CRA-OLI, Agricultural Research Council-Olive Growing and Oil Industry Research Centre, Consiglio nazionale per la ricerca (CNR) and l'Università della Calabria (UNICAL)	Italy	No	https://www.hindawi.com/journals/tswj/2014/296590/	segreteria@certolio.org info@certolio.org staff@certolio.org	© CERTOLIO 2014