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An Integrated Management of Vegetable Agro-Biodiversity: A Case Study in the Puglia Region (Italy) on the Artichoke Landrace 'Carciofo di Lucera'

Angelo Signore [1], Francesco Di Giovine [1], Anita Morgese [2], Gabriella Sonnante [2,*] and Pietro Santamaria [1]

[1] Department of Agricultural and Environmental Science, University of Bari Aldo Moro, Via Amendola 165/A, 70126 Bari, Italy; angelo.signore@uniba.it (A.S.); f.scodigiovine@gmail.com (F.D.G.); pietro.santamaria@uniba.it (P.S.)

[2] Institute of Biosciences and Bioresources, National Research Council, Via Amendola 165/A, 70126 Bari, Italy; anita.morgese@ibbr.cnr.it

* Correspondence: gabriella.sonnante@ibbr.cnr.it

Abstract: The agro-biodiversity of vegetables is threatened, posing major concerns for the future of landraces, which are of fundamental importance both for food safety and for assuring an income to small-scale farmers. To counteract such a trend, the Puglia region (southern Italy) set up a plan to recover, characterize and preserve the resources at risk of genetic erosion. In our paper, we present a case study regarding an artichoke landrace, the 'Carciofo di Lucera' variety, that encompasses all activities foreseen in the Puglia region's plan which is the result of the multi-actor project "BiodiverSO". Such a project allowed us to recover and characterize crop genetic resources and to pave the way for further actions to preserve and valorize the agro-biodiversity of local vegetables that are still present in the Puglia region. Furthermore, we collected some evidence that allowed us to backdate the origin of artichoke cultivation in the Puglia region by about two centuries and, most important of all, to recover some populations of 'Carciofo di Lucera'. These preliminary phases were followed by the characterization of this local variety, both from the morphological and the molecular point of view, so that we can discriminate this landrace from other artichoke varieties more accurately. Eventually, we collected all the information in electronic databases and data sheets, thus providing a tool for the public administration which will be useful in the in situ conservation phase.

Keywords: recovery; database; descriptors; characterization; valorization; keeper farmers

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1. Introduction

Puglia (Southern Italy) is one of the most important regions for vegetable crop production in Italy, as it accounts for 22% (70,340 ha) and 18% (1,413,304 tons) of open-field cultivated area and production at national level, respectively [1]. The prominence of Puglia derives both from the cultivation of commercial varieties and from its great heritage of agro-biodiversity, in particular landraces (LRs) still grown in this region [2]. Unfortunately, such agro-biodiversity richness has been (and still is being) eroded because of several factors [3,4]. To reverse this trend, the Puglia Region Administration has put several measures in place with the aim of identifying and protecting the species/LRs at risk of genetic erosion and recovering them by means of their cultivation [5]. Landraces, the most complete definition of which is reported by Negri et al. [6], have a specific adaptation to the environmental and cultivation conditions of a given area [7–9] and are linked to the traditional culture of a specific region [10]; therefore, they are strongly connected to the context in which they have been developed. In addition, LRs may have both a commercial and/or a cultural value, as they can furnish products with a high-quality profile that is reflected in several geographical indications. Indeed, geographical indications, such as Protected Designation of Origin (PDO), Protected Geographical Indication (PGI) and Traditional Specialties Guaranteed (TSG), represent a sort of "business card" for Italian excellence worldwide, as such

geographical information denotes "the link between territory, culture, and agriculture" [11]. Furthermore, the importance of agro-biodiversity lies in its ability to furnish ecosystem services and to serve as a basis for "new" products, cropping systems and cultivars and the selection of varieties that are resistant to pests and changing environmental conditions [12]. On the other hand, the plant genetic resources (PGRs) belonging to such agro-biodiversity and the knowledge associated with them (seed production, ethnobotany, crop practices, etc.), are held by farmers who are usually more than 65 years old [13].

Given what has been mentioned above, the importance of defending and recovering the still existing LRs is pronounced, as these genetic resources are severely threatened [14]. Similarly, the agro-ecosystem functions served by genetic resources, namely, food, regulation and cultural services [15,16], are endangered.

In this article we report the actions that were undertaken in the frame of the BiodiverSO project (Biodiversity of vegetable species of the Puglia region: https://biodiversitapuglia.it, last accessed on 15 January 2022) to counteract the erosion of vegetable PGRs in the Puglia region by considering a landrace of globe artichoke, 'Carciofo di Lucera' (CdL from now onward), as a case study among the 122 local vegetable varieties belonging to 33 species that have been recovered. The choice of CdL as a case study is due to the peculiarity of the artichoke varieties currently cultivated in the Puglia region. Indeed, farmers started to grow the early or re-blooming artichoke varieties quite recently (60–70 years ago), particularly in the coastal zones. Before then, late varieties, such as CdL, were cultivated, since they needed vernalization to bloom.

2. Materials and Methods

BiodiverSO was a collaborative multi-actor project, involving fifteen partners from different spheres, namely, academia, research institutions, private companies and public consortia, each with different skills (agriculture and crop production, genetic diversity, germplasm safeguarding, (bio)chemistry, plant science, engineering and biotechnology). The scheduled activities of the project were organized in eight work packages (WPs) [17], that were simultaneously developed by one or more partner(s), namely:

WP1—History
WP2—Recovery
WP3—Ex situ conservation
WP4—Characterization
WP5—Sanitation
WP6—Databases
WP7—Data sheets
WP8—In situ conservation

2.1. WP1—History

This was the preparatory phase of the project, in which a set of searches were conducted to find historical references related to CdL. For this purpose, several sources, both offline and online, were consulted. In order to retrieve information on artichoke cultivation in some areas of the Puglia region, we visited the libraries in Lucera town (province of Foggia, Puglia), the Faculty of Agriculture of the University of Bari, the public State Archive of Foggia city, and private collections. Regarding the online searches, we consulted the Italian National Library Service Catalogue [18], Google Scholar and Google Books. In addition, thanks to various reports (farmers, students, etc.), local surveys were performed by visiting fields growing CdL that were located in the countryside of Lucera.

2.2. WP2—Recovery

Starting from the data gathered in WP1, the landrace of CdL hold by local farmers was collected, together with information related to geographical, topographical, cultivation and daily use aspects. At the same time, offshoots from healthy plants were taken and subsequently planted in a field (41°32′56.8″ N 15°20′26.9″ E) to carry out char-

acterization (WP4) activities. All the accessions were georeferenced with GPS (Global Positioning System) and the data were collected into a GIS (Geographic Information System), allowing the creation of a thematic cartography available at the following URL: https://biodiversitapuglia.it/webgis.php (last accessed on 15 January 2022). The collection of information and field georeferencing were performed by means of portable hardware using some emerging technologies, such as Open Data Kit [4], and then the data were transferred into the BiodiverSO Management System (BMS).

2.3. WP3—Ex Situ Conservation

The vegetative material deriving from WP2 was brought to the Institute of Biosciences and Bioresources of the National Research Council (IBBR-CNR) for ex situ conservation in a field collection held at Valenzano (Bari, Italy). At least five offshoots from each original collection site were planted in a row at a distance of 1.0 m between plants and 1.3 m between different accessions. The field collection undergoes standard agricultural practices used for artichoke cultivation in the Mediterranean area [19].

2.4. WP4—Characterization

This activity encompassed both morphological and molecular characterizations of CdL. Morphological traits were recorded following the "Guidelines for the conservation and characterization of plant biodiversity of interest for agriculture" of the Italian Ministry of Agricultural, Food and Forestry Policies [20], which are based on the UPOV (International Union for the Protection of New Varieties of Plants) descriptors, as a guide to perform plant morphological and productive characterization.

In November 2014, CdL accessions identified in WP1 were collected and the main information related to geographical distribution, topographical maps, cultivation and use were gathered. The accessions were photographed, and the collection sites were georeferenced by a GPS system; thus, the data were processed through GIS. This information was used for the creation of a cartography (https://biodiversitapuglia.it/webgis.php-last (accessed 15 January 2022), by means of which the user is able to combine several kinds of map visualization (standard, soil use, etc.) with other data (project partners, farms, species, local varieties, etc.).

At the same time, offshoots were taken from randomly chosen healthy plants and, according to local custom, the distal parts of the leaves were removed. Offshoots were then placed into boxes, covered with damp cloths and brought to a farm ("Di Giovine"), located in the countryside of Lucera (41°32′56.8″ N 15°20′26.9″ E) at an altitude of 99 m above sea level for the development of WP4.

The three accessions were cultivated in nine plots (three plots for each accession) using a completely randomized scheme. The experimental trial for morphological and productive characterizations was carried out at the same farm as mentioned above between 19 October, 2014 and 30 June 2015.

The crop was managed according to local cultivation practices. The soil was prepared by means of a harrow to a depth of 60 cm, followed by another process to refine the soil with a mill. The offshoots of CdL were placed at 1.30 m in a row, with 1 m between the rows, over a total area of 576 m^2. Irrigation was carried out with sprinklers with a flow of 0.6 $m^3 \cdot h^{-1}$. At harvest time, flower heads were cut with 10 cm stems.

For morphological characterization, in the case of mature plants of the three different CdL populations, the most important characters identified through UPOV were scored, in particular those required by GIBA (Italian acronym for Gruppo di Lavoro Biodiversità Agricola—Agricultural Biodiversity Working Group) and those useful for the inscription of CdL into the "Common catalogue", as a conservation variety [21]. The following parameters were considered: (i) height and weight of the plant; (ii) diameter of the stem; (iii) length and width of the flower head (with and without the stem); (iv) diameter of receptacle, longitudinal and transverse dimensions of bracts; (v) presence/absence of pappus; (vi) shape of receptacle; (vii) color of internal and external bracts; and (viii) presence

of thorns on the bracts and on the leaves. Morphological and productive data were analyzed with a one-way variance procedure. The mean values (n = 3) were separated using the LSD test (p = 0.05).

For molecular analyses, young leaves were collected from three individuals of each accession and immediately frozen at −80 °C. DNA extraction was carried out following [22]. Microsatellite (simple sequence repeat, SSR) amplification was performed using 17 primer pairs (Supplementary Table S1), as described in Gatto et al. [23]. A protocol including an M13 primer was used in a total volume of 10 µL containing 2.5 ng DNA, 0.07 µm forward primer with an 18 bp M13 tail, 0.2 µm reverse primer, 0.2 µm of 18 bp M13-labelled primer (Sigma-Aldrich, Milan, Italy), 0.2 mm of each dNTP, 1 µL 10 × buffer, 0.4 U Taq DNA polymerase (Invitrogen, Carlsbad, CA, USA) and 1.5 mm MgCl2. Amplification was as follows: 3 min initial denaturation at 94 °C, 38 cycles of 30 s at 94 °C, 30 s annealing at optimal primer temperature [24] and 45 s synthesis at 72 °C, followed by a final 10 min extension at 72 °C. PCR products were analyzed on a CEQ 8800 automated sequencer (Beckman Coulter, Carlsbad, CA, USA), and peaks were identified by comparison with an internal size standard, using the sequencer software. Allele frequencies from CdL populations and other artichoke varieties previously analyzed [23] (see Results section) were used to construct a UPGMA dendrogram based on Nei's genetic distance [25].

2.5. WP5—Sanitation

The phytosanitary status of several local varieties of artichokes was assessed in the course of the project, according to the EU Directives 93/61/CEE and 93/62/CEE that require nursery productions to be virus-free [26].

2.6. WP6—Databases

The information collected throughout the project by the different partners (listed here: https://biodiversitapuglia.it/partner/, last accessed on 15 January 2022) was stored in a database called BMS, arranged in several subsections, as follows:

- Species and varieties;
- Farms descriptive sheet;
- Resources descriptive sheet;
- Descriptors;
- Varietal sheets.

For reasons of space, the description of each subsection and related pictures are reported in the Supplementary Materials.

2.7. WP7—Data Sheets

For each landrace, the information collected was reported in data sheets. In every sheet, details about the crop, the production period, the edible part and the territory in which the landraces were cultivated can be found (see Supplementary Figure S1). In some cases, ethnobotanical information is also present. Such data sheets are available both online (https://biodiversitapuglia.it/biblioteca/?ids=2945, https://biodiversitapuglia.it/varieta-orticole/ and https://drive.google.com/file/d/1HZsoaay07u4nDIZVP1wmW_VnH3Ss06Uf/view (last accessed on 15 January 2022)) and as printed books.

2.8. WP8—In Situ Conservation

In situ conservation was performed by reproducing the landrace for maintenance purposes, using traditional cultivation methods. The outcomes of this work package were some concise data sheets that were used by technicians of the Puglia region to fulfil the payment requests of the farmers who have cultivated such landraces over the years.

3. Results

3.1. WP1—History

Among the books consulted within the BiodiverSO project, interesting information was found in a volume entitled *The Medieval Saracens of the Minor Towns of the Capitanata* (in Italian, *I Saraceni medievali delle località minori della Capitanata*, 2013). Capitanata is a historical-geographical district of the Puglia region, while Saracens is a term used in Europe during the Middle Ages to refer to Muslims, primarily of Arabic origin, but also of Turkish and Persian/Iranian origin. This book reports several vernacular entries stemming from the Arabic language, such as "skarciofele", deriving from the Arabic "haršūf", namely, artichoke. Starting from this finding, we searched for other possible relationships between CdL and the Saracens. Another book, *The Saracen Colony of Lucera and its Destruction* (in Italian, *La colonia saracena di Lucera e la sua distruzione*, 1912), has clarified the association between artichokes and the Saracens in Lucera; in the 13th century, the town was "exhausted and empty of inhabitants" and, for that reason, the emperor Frederick II moved a Saracen colony of "Muslim rebels" to Lucera. In a book by Amari [27], which compared the Spanish version by Banqueri *Libro de agricultura* (1802) with the French version by Clément-Mullet *Le livre de l'agriculture* (1864), we found a citation to a book by Ibn al-Awwām (12th century) (Supplementary Figures S2 and S3). Such research brought to light some information regarding the cultivation of kinaria (artichoke), which was due to the Saracens present in this territory, as was the cultivation of several other crops in the area surrounding Lucera. In fact, it is assumed that the Arabs played an important role in the diffusion of artichokes during their domination of southern Mediterranean countries in the Middle Ages [28].

Besides analyzing written sources, during site inspections, farmers were interviewed to collect knowledge related to history which has been passed down orally. These interviews were edited and collected in several publications, available both in paper and electronic formats (see https://biodiversitapuglia.it/editoria/, last accessed on 15 January 2022).

The presence of the artichoke in Lucera since ancient times is confirmed also in architectural works, and precisely on a bas-relief placed on the architrave of a noble residence called Palazzo Lombardi (18th century), that could derive from the reuse of architectural materials from the 13th century Swabian–Angevin fortress located in Lucera [29] (Figure 1).

3.2. WP2—Recovery

Several reports from local people indicated the presence of CdL in the area of Lucera. After a pre-screening to exclude artichoke material that did not correspond to the CdL description, three populations of CdL were recovered from three different sites. The accessions were complemented with photographic documentation, the collection sites were geo-referenced using a GPS system and the data obtained were processed through GIS. All the information was added to a thematic distribution map created for the purpose (Figure 2).

3.3. WP3—Ex Situ Conservation

Offshoots of CdL plants were separated from the mother plants in the three localities where this artichoke landrace was found and were transplanted in the field collection of the Institute of Biosciences and Bioresources, CNR, in Valenzano, Bari (Italy). At least five plants from each collection site were maintained, following standard agricultural practices for artichoke cultivation [19].

Figure 1. Door of Palazzo Lombardi (18th century). In the upper part of the picture, details of the architrave with a bunch of artichokes.

3.4. WP4—Characterization

3.4.1. WP4.1—Morphological and Productive Characterization

An initial visual examination of the artichoke plants and flower heads evidenced only small differences among samples that did not allow us to discriminate the three populations. However, by using UPOV descriptors (Table 1), we detected that plants from population 3 (POP3) showed a greater vigor, fewer incised leaves and more rounded and larger flower heads (Figure 3 and Tables 2 and 3). These differences were later confirmed by the molecular characterization (see below, "WP4.2—Molecular characterization").

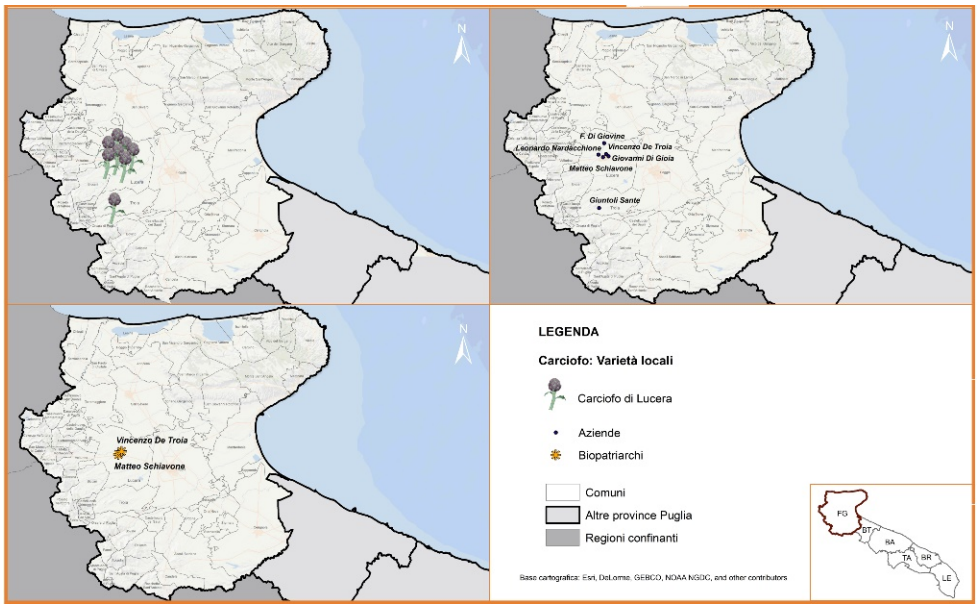

Figure 2. Distribution map of the 'Carciofo di Lucera' artichoke, generated by the management system of the project BiodiverSO (in Italian). The lower right quadrant reports the figure legend (Legenda), from top to bottom: Artichoke local varieties; "Carciofo di Lucera"; Farms; Bio-patriarchs; Municipalities (white rectangle); Other provinces in Puglia (light grey rectangle); Bordering regions (dark grey rectangle).

Table 1. Morphological descriptors for the three populations according to UPOV and GIBA. The descriptors in red are the ones required for the entry in the conservation varieties catalogue.

UPOV Descriptor #	Parameter	Populations 1–2	Population 3	Expression
1.1	Plant height	3	4	Short
2	Leaf: attitude	1	1	Erect
3	Leaf: intensity of lobing	7	6	Present
6	Leaf blade: blistering	1	1	Absent
7	Leaf blade: color	5	5	Grey green
16	Midrib: length of spines	1	1	Absent
18.1	Main stem: height from base to central flower head	3	4	Short
20	Central flower head: length	7	7	Long
21	Central flower head: diameter	7	7	Large
22	Central flower head: shape in longitudinal section	3	1	Ovate
23	Central flower head: shape of apex	2	2	Rounded
24	Central flower head: anthocyanin coloration of inner bracts	5	5	Medium
25	Central flower head: density of inner bracts	7	7	Dense
26	Receptacle: diameter	6	6	Medium–large
27	Receptacle: thickness	5	5	Medium
28	Receptacle: shape in longitudinal section	2	2	Moderately depressed
29	Central flower head: time of beginning of opening	7	7	Late
30	Outer bract: violet colour on external side	2	2	Weak
34	Outer bract: reflexing of tip	9	9	Outwards
35	Outer bract: length of spine	3	3	Short
36	Outer bract: mucron	9	9	Present

Table 1. *Cont.*

UPOV Descriptor #	Parameter	Populations 1–2	Population 3	Expression
37	Outer bract: shape	3	3	Longer than broad
38	Outer bract: length of the base	5	5	Medium
39	Outer bract: thickness at base	7	7	Thick
GIBA Descriptors #	**Parameter**	**Populations 1–2**	**Population 3**	**Expression**
18	Leaf limb: shade of green color	1	1	Absent
20	Leaf limb: pubescence of the upper page	1	1	Absent or very weak
25	Central flower head: size	6	6	Large
32	First lateral flower head: size	5	6	Medium
33	First lateral flower head: shape in longitudinal section	3	1	Oval
36	Internal bracts: base width	7	7	Large
41	External bracts: shade of the secondary colour	2	2	Bronze

Table 2. Total production, total yield, total number of flower heads (secondary and tertiary), plant diameter, height and diameter/height ratio of three populations of 'Carciofo di Lucera' [(1)].

Population	Total Yield (g/Plant)	Total Flower Heads (n./Plant)	Secondary Flower Heads (n./Plant)	Tertiary Flower Heads (n./Plant)	Plant Diameter (m)	Plant Height (cm)	Diameter/Height Ratio (cm/cm)
POP1	573 ab	5.0 b	3.8 a	0.3 b	2.0 ab	47.9	4.27
POP2	343 b	3.2 c	2.1 b	0.1 b	1.8 b	43.1	4.34
POP3	812 a	6.3 a	2.7 b	2.7 a	2.1 a	43.0	5.13
Significance [(1)]	*	**	**	***	*	ns	ns

Averages marked with different letters are significantly different for $p = 0.05$. [(1)] Significance of F: n.s., *, ** and *** not significant and significant for $p \leq 0.05$, $p \leq 0.01$ and $p \leq 0.001$, respectively.

Table 3. Characteristics of the shape, receptacle and bracts of the main flower heads of three populations of 'Carciofo di Lucera' [(1)].

Population	Shape [(a)]	Receptacle Diameter (cm)	Receptacle Thickness (cm)	Bract Width (cm)	Bract Thickness (cm)	Violet Color	Pappus
POP1	1.00 ab	3.85	1.48	2.45	0.51	0.83 b	0.58
POP2	0.83 b	4.58	1.59	2.94	0.63	2.08 a	1.83
POP3	1.50 a	3.86	1.81	2.71	0.60	1.08 b	1.08
Significance [(1)]	*	ns	ns	ns	ns	*	ns

Averages marked with different letters are significantly different for $p = 0.05$. [(1)] Significance of F: n.s. and * not significant and significant for $p \leq 0.05$, respectively. [(a)] Receptacle shape: 0 = flat, 1 = slightly depressed, 2 = depressed.

To better characterize the three populations, other parameters were considered, specifically those reported in Tables 2 and 3 related to flower heads. The total yield was higher in POP3, even though it was not significantly different from POP1, due in particular to a higher number of main and tertiary flower heads, while POP1 produced more secondary flower heads (Table 2). The height of the plant was similar for all populations, while the diameter of POP2 was smaller with respect to the other populations (Table 2).

Morphological characteristics of the receptacle and bracts highlighted few differences among populations: POP3 had a more depressed receptacle compared to POP2 and POP2 external bracts showed a more intense violet color than the other populations (Table 3).

Population #1

Population # 2

Population # 3

Figure 3. The three populations of 'Carciofo di Lucera' considered for their morphological characterization.

3.4.2. WP4.2—Molecular Characterization

The molecular analyses based on 17 SSR markers were carried out on the three populations of CdL. Markers were selected according to their ability to distinguish among the main morpho-agronomic artichoke groups, namely, 'Catanesi', 'Violetti', 'Spinosi' and 'Romaneschi' [23]. The 'Violetti' group includes varietal types with violet-coloured heads harvested in the early springtime; the 'Romaneschi' artichokes are characterized by big, spherical or elliptical flower heads and are harvested late in the spring; the 'Spinosi' types carry bracts and leaves with long thorns; and the 'Catanesi' group is characterized by varieties with quite small, elongated heads, the color of which is green with violet nuances. The latter two groups are considered as early or "re-flowering" types and are usually harvested for a longer period, from late autumn to spring [30].

In order to assess relationships between CdL populations and other varieties, SSR markers from CdL were analyzed together with SSRs at the same loci previously obtained in 11 artichoke varieties representing the main morpho-agronomic groups [23], namely, 'Carciofo di Mola', 'Brindisino', 'Violetto di Provenza' (Catanesi types); 'Tondo di Paestum', 'Romanesco' (Romaneschi types); 'Carciofo di S. Erasmo', 'Violetto di Maremma' (Violetti types); 'Spinoso di Palermo', 'Spinoso Violetto di Liguria', 'Spinoso Sardo' (Spinosi types); Blanca de Tudela (Out, none of the main types). In total, 76 alleles were scored, from a minimum of three for CYEM182, CYEM210 and CELMS14 loci, to a maximum of seven (CYEM218 and CYEM291). The dendrogram based on allele frequencies and Nei's genetic distance (Figure 4) highlights the presence of two main branches. In the lower cluster, two groups can be observed: the 'Violetti' artichokes on one side, and the 'Spinosi' types on the other. The upper part of the graph contains two main clusters, with the lower one including the 'Catanesi' types, which are very closely related, and the Spanish variety 'Blanca de Tudela' at a much greater distance. The upper group contains the 'Romaneschi' artichokes and CdL populations. While POP1 and POP2 of CdL are practically identical, POP3 is more distantly related. The belonging of CdL to the 'Romaneschi' typology was also confirmed by SNP markers derived from a GBS (Genotyping by Sequencing) analysis [31].

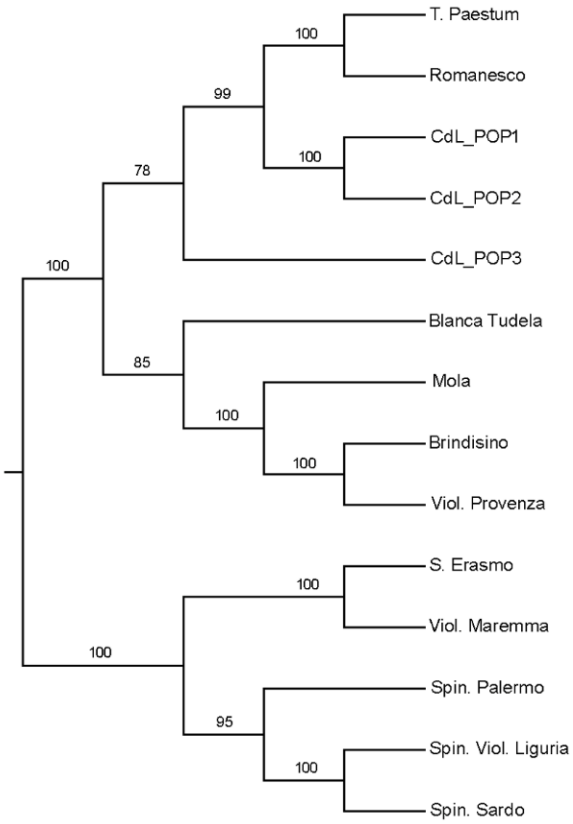

Figure 4. UPGMA dendrogram based on SSR markers in some artichoke landraces. CdL: Carciofo di Lucera. Numbers above branches indicate bootstrap values.

3.5. WP5—Sanitation

In order to assess the health condition of artichoke plants, all the artichoke local varieties collected in the framework of the BiodiverSO project were tested to determine whether the most common viruses were present. All the local varieties were found positive, individually or all of them, for AILV (artichoke Italian latent virus), ArLV (artichoke latent virus), TuMV (turnip mosaic virus) and TICV (tomato infectious chlorosis virus) [26], with CdL in particular containing the ArLV. For this reason, the artichoke plants collected were subjected to a sanitation process by meristem tip culture and in vitro thermotherapy [26].

3.6. WP6—Databases

The database used for the end of the project included a huge number (475) of tables; hence, here we will report only the description of the items related to this article.

The section containing species and varieties (Supplementary Figure S4) allowed the project's partners to add (and edit) all the local varieties into the database so that the changes to this section were consistently reflected throughout the entire database. Furthermore, this section allowed the partners to create the descriptive sheets not only for the genetic resources but also for the farms where they were cultivated (Supplementary Figures S5 and S6).

The workflow started with the section "Farms description sheet" (Supplementary Figure S5), containing the information about the farm and the farmers, and a section that might contain further details of the local variety. In the first tab (Supplementary Figure S5), several fields were filled to geolocate the farm and add additional details, such as the name of the farm, its orography, altitude above the sea level and soil characteristics (slope, exposure and soil texture). In the second tab (Supplementary Figure S5), it was possible to add information regarding the farmers (name, age, etc.).

The completion of the "Farms description sheet" section unlocked the workflow for adding an entry in the "Resources description sheet" section, in which different information may be added (Supplementary Figures S1, S6 and S7). The first tab contains general data regarding the geolocation of the resource, species and local varieties, and is linked to the farm on which it is cultivated. In the other tabs, more specific information can be added, such as the cultivated area, when the local varieties are cultivated, and the agricultural practices (irrigation, weeding, hoeing, etc.). Other information concerning agronomic characters, biotic and abiotic stresses, organoleptic qualities, the way that the genetic resource is propagated, together with ethnobotanical data, can be added in the other tabs (Supplementary Figures S1, S6 and S7), allowing a more complete characterization of the genetic resource.

The last step of the database was the section dedicated to the descriptors of the local varieties. In this section, the several partners (either public or private, farms or research centers) added the collected information related to the different local varieties (Supplementary Figures S8 and S9).

Once the partner had entered some data, he/she could save them as a draft or ask for evaluation. In the latter case, the scientific partner acting as coordinator was warned by email and could take a decision, i.e., "Approve", "Reject" or "Ask for further modification", and this was cycled until the descriptors were properly filled.

The adopted workflow and the database structure allowed us to cross-reference the genetic resources and the farms: in this way, several genetic resources might be ascribed to a single farm, and several farms might cultivate a single crop. The descriptors' section was tailored to every species and allowed every partner to realize a very accurate card as it was a guided path using UPOV descriptors as a reference.

3.7. WP7—Data Sheets

With the purpose of making it easier to find and describe CdL plants, a synoptic sheet (in Italian) was prepared for CdL containing the most relevant information regarding this local variety (Figure 5).

In addition, for dissemination throughout the territory of the Puglia region, CdL was included in the books *Almanacco BiodiverSO* (https://biodiversitapuglia.it/wp-content/uploads/2018/03/Almanacco_BiodiverSO.pdf, accessed on 15 January 2022) and *Racconti raccolti* (https://biodiversitapuglia.it/biblioteca/?ids=2945, accessed on 15 January 2022).

Figure 5. Synoptic sheet for 'Carciofo di Lucera', generated by the management system of the project BiodiverSO (in Italian) and extrapolated from [32]. The upper part of the image contains the name of the local variety ("di Lucera") and a description: "The Carciofo di Lucera is cultivated in small gardens by old farmers, using traditional farming systems. The globe artichoke cultivation in the town of Lucera might date back to 1200, during the reign of Sicily of the emperor Frederick II, centuries before the Spanish dominion, to which the introduction of this crop is often attributed in southern Italy". Other information present in this sheet is referred to (i) production: harvest time (March to May), duration of the crop cycle (7–9 months); (ii) edible part: diameter × length (7 × 10 cm), weight (130–200 g), uniformity (average). At the bottom, a picture of four artichokes (left) and the territory (right) where this landrace was found (the Puglia Region, and, in red, the province of Foggia), with the representative municipality: Lucera town.

Eventually, the data sheets furnished a very simple and clear tool for both the general public and the staff of the Puglia region to identify (and report) the different local varieties that were included in the database.

3.8. WP8—In Situ Conservation

Within the project, a specific directive promoted the cultivation of crops/landraces at risk of genetic erosion and the creation of a system to maintain local agrobiodiversity, through the identification of the so-called "keeper farmers" (KFs), i.e., farmers who have maintained local varieties over decades. For the duration of the project, there were no KFs for CdL, since this landrace was not included in the list of varieties for payments to farmers.

Currently, CdL is included in such a list, an important step to avoid the loss of this genetic material, as CdL is cultivated mainly by old KFs and in small areas. Moreover,

the registration of CdL in the national registers as a conservation variety will increase the possibility of in situ conservation, as reported by Santamaria and Signore [21].

4. Conclusions

The BiodiverSO project allowed us to get an overview of vegetable agro-biodiversity in the Puglia region. We found and recovered 122 local varieties of vegetables belonging to 32 different species. The workflow of the project covered several aspects related to the local varieties, from historical information to in situ and ex situ conservation. With respect to 'Carciofo di Lucera', the project allowed us to recover three populations cultivated by a small number of farmers located in the countryside of Lucera town. During the recovery of the resource from the field, we collected several items of information that have allowed us to backdate artichoke cultivation in the Puglia region by about 200 years and to fully characterize 'Carciofo di Lucera' and ascribe this landrace to the 'Romanesco' typology, thanks to its molecular characterization. All the information collected in the database produced a data sheet that will be used by regional technicians to allocate funding to the keeper farmers and, eventually, to maintain such a resource in its original cultivation site for in situ conservation. Furthermore, sanitation by the means of meristem tip culture and in vitro thermotherapy will allow other farmers to cultivate this artichoke landrace safely in the near future. This is even more important when we consider that the old varieties often contain a higher inulin content compared to the new varieties, therefore they are interesting both from a nutraceutical and technological point of view.

Finally, the findings from the current project may help the Puglia Region Administration to improve its legislation. Indeed, following the characterization, CdL may be included in both the Regional Register established by Regional Law No 39/2013 (aimed at protecting and conserving breeds, species, landraces, cultivars, clones and populations of regional interest) and in the National Register of Biodiversity managed by the Italian Ministry of Agriculture, Food and Forestry (Ministerial Decree no. 38,654 of 4 November 2019 and Ministerial Decree no. 13,073 of 17 April 2020).

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/horticulturae8030238/s1, Figure S1: *Libro de agricultura*, translated by Banqueri (1802), pages 302 and 303, from Google books, Figure S2: *Le livre de l'agriculture*, J.-J. Clément Mullet (1866), pages 291 and 292, from Google books, Figure S3: Section for the management of the collected species and varieties, Figure S4: Farm description sheet, Figure S5: Resources description sheet (introduction tab), Figure S6: Resources description sheet (agronomic characteristics), Figure S7: Resources description sheet (organoleptic and nutritional qualities, market factors, etc.), Figure S8: Main tab for the characterization of the variety, Figure S9: Tab for the characterization of the main flower head of CdL, Table S1: Molecular markers designed for foreground selection of three targeted loci, Table S1: Microsatellite markers used in this study. Locus name, sequence of primer pairs and annealing temperature (Ta) are provided.

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