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Editorial

Biodiversity of Vegetable Crops, A Living Heritage

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Abstract: Biodiversity is the natural heritage of the planet and is one of the key factors of sustainable development, due to its importance not only for the environmental aspects of sustainability but also for the social and economic ones. The purpose of this Special Issue is to publish high-quality research papers addressing recent progress and perspectives while focusing on different aspects related to the biodiversity of vegetable crops. Original, high-quality contributions that have not yet been published, or that are not currently under review by other journals, have been gathered. A broad range of aspects such as genetic, crop production, environments, customs and traditions were covered. All contributions are of significant relevance and could stimulate further research in this area.

Keywords: agriculture; landraces; local varieties; plant genetic resources populations; wild edible plants

1. Introduction

Intensive agriculture has generally determined a higher productivity, but also a decrease in agro-biodiversity, whose preservation represents a key-point to assure adaptability and resilience of agro-ecosystems to the global challenge (to produce more and better food in a sustainable way). Many components of agro-biodiversity would not survive without human interference, but human choices may also represent a threat for agro-biodiversity preservation [1].

The biodiversity in vegetable crops is underpinned by genetic diversity, which includes species diversity (interspecific diversity), the diversity of genes within a species (intraspecific diversity) that refers to the vegetable grown varieties, and by the diversity of agro-ecosystems (agro-biodiversity). Intraspecific diversity is very abundant in vegetable crops and is not reflected, at least not at the same extent, in other groups of crops. The labor operated by farmers over centuries of selection has led to the creation of a plurality of local varieties starting from the domestication of a wide agro-biodiversity forms, a precious heritage both from a genetic and a cultural-historical point of view. Therefore, the agro-biodiversity related to vegetable crops has assumed very articulated connotations. It is also important to specify that a "local variety" (also called a landrace, farmer's variety, or folk variety) is a population of a seed- or vegetative-propagated crop characterized by greater or lesser genetic variation, which is however well identifiable and which usually has a local name [1].

In facing the challenges of the modern vegetable growing sector, the many expressions of vegetable biodiversity are a key source for genetic improvement programs, and play a crucial role to produce innovative vegetables with improved qualitative characteristics (crop diversification and new crops), to realize more environmentally sustainable agro-systems, to cope with issues of climate change, and to

find better adaptation to marginal soil conditions (salinity, atmospheric pollutants, etc.), while not forgetting the need to recover and maintain links with history and folk traditions [2].

Unfortunately, the genetic diversity of vegetable crops in many regions of the world has been eroded due to several factors such as abandonment of rural areas, ageing of the farming population, and failure to pass information down the generations (leading to loss of knowledge and historical memory), which can vary in relation to the type of genetic resource and location [1].

In this view, it is important to create a biodiversity network in order to promote the exchange of information between stakeholders and facilitate the diffusion and protection of these genetic resources by: collecting and preserving memories and knowledge of biodiversity in vegetable crops; retrieving and identifying such landraces wherever they can be found; characterizing, cataloguing and preserving them [3–5]. On the other hand, it must be underlined that the conservation of genetic biodiversity should be based not only on institutional and private plant breeders and seed banks, but mainly on the vast number of growers who continuously select, improve, and use vegetable biodiversity at the local scale. This availability of *in situ* biodiversity may be able to meet not only the requirements of breeders, but also the needs of specific niche markets, characterized by high demand for local products grown with environmentally-friendly farming techniques [3,4].

The purpose of this Special Issue is to publish high-quality research papers addressing recent progress and perspectives in different aspects related to the biodiversity of vegetable crops.

2. Papers in This Special Issue

The Special Issue "Biodiversity of Vegetable Crops, A Living Heritage" presents ten papers, focusing on a wide range of research activities and topics.

The first article concerns "A Protocol for Producing Virus-Free Artichoke Genetic Resources for Conservation, Breeding, and Production" by Roberta Spanò, Giovanna Bottalico, Addolorata Corrado, Antonia Campanale, Alessandra Di Franco and Tiziana Mascia [6]. This research article starts by suggesting that the potential of the globe artichoke biodiversity in the Mediterranean area is enormous but at risk of genetic erosion because only a limited number of varieties are vegetatively propagated and grown. In Puglia (Southern Italy), many globe artichoke ecotypes remained neglected and unnoticed for a long time and have been progressively eroded by several causes, including a poor phytosanitary status. This article describes a sanitation protocol based on the combination of in vitro meristem-tip culture and thermotherapy for the production and the *ex situ* conservation of virus-free propagation material of artichoke, in accordance with the EU Directives 93/61/CEE and 93/62/CEE. Five Apulian local varieties (Bianco di Taranto, Francesina, Locale di Mola, Verde di Putignano and Violetto di Putignano) were sanitized from artichoke Italian latent virus (AILV), artichoke latent virus (ArLV) and tomato infectious chlorosis virus (TICV) and a total of 25 virus-free primary sources were obtained and conserved *ex situ* in a nursery.

The second contribution explores "The Deterioration of Morocco's Vegetable Crop Genetic Diversity: An Analysis of the Souss-Massa Region" by Stuart Alan Walters, Rachid Bouharroud, Abdelaziz Mimouni and Ahmed Wifaya [7]. In this article, an assessment of the current status of vegetable landraces in the Anti-Atlas mountain areas of the Souss-Massa region (Southwestern Morocco) performed during 2014 is reported. It outlines how crop domestication and breeding efforts during the last half-century in developed countries significantly reduced the genetic diversity in Morocco. Results of this research showed that a significant loss of vegetable crop landraces (about 80-90%) has occurred in the last 30 years in this region of Morocco. Vegetable landraces that were notably lost during this time period included carrot (*Daucus carota* L.), fava beans (*Vicia faba* L.), melon (*Cucumis melo* L.), pea (*Pisum sativum* L.), watermelon (*Citrullus lanatus* L.), and especially tomato (*Solanum lycopersicon* L.). Authors highlighted that this genetic erosion will have a profound influence on future Moroccan agricultural productivity, since the genetic diversity within these landraces may be the only resource available to allow local farmers to cope with changing environmental conditions and optimize crop production in their harsh climate.

The third paper illustrates the "Quality and Nutritional Evaluation of Regina Tomato, a Traditional Long-Storage Landrace of Puglia (Southern Italy)" by Massimiliano Renna, Miriana Durante, Maria Gonnella, Donato Buttaro, Massimiliano D'Imperio, Giovanni Mita and Francesco Serio [8]. Regina (Italian for "Queen") tomato, an Italian local variety grown in the coastal saline soils of the central Puglia, is listed as an item in the 'List of Traditional Agri-Food Products' of the Italian Department for Agriculture and itemized as 'Slow Food presidium' by the Slow Food Foundation. This local variety is classified as a long-storage tomato since it can be preserved for several months after harvest thanks to its thick and coriaceous skin. In this research article three ecotypes were investigated for the main physical and chemical traits both at harvest and after three months of storage. Experimental results indicate that Regina tomato has a qualitative profile characterized by high concentrations of tocopherols, lycopene and ascorbic acid even after a long storage time, as well as lower average glucose and fructose contents compared to other types of tomatoes. Authors highlighted the high nutritional value of this local variety, especially for people with specific dietary requirements, as well as the possibility to use these results as a tool for obtaining the Protected Geographical Indication or Protected Designation of Origin mark.

The fourth article is the "Cultivation of Potted Sea Fennel, an Emerging Mediterranean Halophyte, Using a Renewable Seaweed-Based Material as a Peat Substitute" by Francesco Fabiano Montesano, Concetta Eliana Gattullo, Angelo Parente, Roberto Terzano and Massimiliano Renna [9]. Sea fennel (*Crithmum maritimum* L.) is a halophyte species belonging to the *Apiaceae* family that is used in folk medicine as well as in many traditional dishes for its interesting sensory attributes. For this research, the authors used three posidonia (*Podisonia oceanica* (L.) Delile)-based composts (a municipal organic solid waste compost, a sewage sludge compost, and a green compost) by hypothesizing that the halophytic nature of sea fennel allows to overcome the limitations of high-salinity compost-based growing media. Results of this research article show the possibility of using posidonia compost-based substrates without any negative effect on the sea fennel growth in comparison with a commercial peat substrate. Therefore, the authors suggest that these substrates can be used as a sustainable peat substitute for the formulation of soilless mixtures to grow potted sea fennel plants, even up to a complete peat replacement.

The fifth contribution titled "Phytochemical Analysis and Antioxidant Properties in Colored Tiggiano Carrots" by Aurelia Scarano, Carmela Gerardi, Leone D'Amico, Rita Accogli and Angelo Santino" [10] assesses the content of carotenoids, anthocyanins, phenolic acids, sugars, organic acids, and antioxidant activity in a carrot landrace of Southern Italy also called Carrot of Saint Ippazio. The authors indicated that this yellow-purple carrot has a higher level of bioactive compounds, together with the highest antioxidant capacity, compared to the yellow and cultivated orange varieties. These results point out the nutritional value of Tiggiano carrots and may contribute to the valorization of this local variety. Moreover, the presence of bioactive compounds highlights on the possible activation of the anthocyanin biosynthetic pathway in the taproots.

The sixth article is "Conservation of Crop Genetic Resources in Italy with a Focus on Vegetables and a Case Study of a Neglected Race of Brassica Oleracea" by Karl Hammer, Vincenzo Montesano, Paolo Direnzo and Gaetano Laghetti [11]. In this study the authors provide a summary of the conservation strategies for autochthonous agrobiodiversity in Italy with a special focus on vegetables. The paper also offers an outlook on the most critical factors of *ex situ* conservation and actions which need to be taken. Some examples of 'novel' recovered neglected crops are also given. Finally, a case study is proposed on 'Mugnolicchio', a rare landrace of *Brassica oleracea* L., cultivated in Southern Italy, that might be considered as an early step in the evolution of broccoli (*B. oleracea* L. var. *italica* Plenck).

The seventh contribution concerns "Issues and Prospects for the Sustainable Use and Conservation of Cultivated Vegetable Diversity for More Nutrition-Sensitive Agriculture" by Gennifer Meldrum, Stefano Padulosi, Gaia Lochetti, Rose Robitaille and Stefano Diulgheroff [12]. This study reviewed the uses, growth forms and geographic origins of cultivated vegetables worldwide and the levels of research, *ex situ* conservation, and documentation they have received in order to identify gaps and

priorities for supporting a more effective use of global vegetable diversity. A total of 1097 vegetables were identified in a review of the Mansfeld Encyclopedia of Agricultural and Horticultural Plants. The article reports that documentation for most vegetable species is poor and the conservation of many vegetables is largely realized on farms through continued use. Therefore, the authors suggest that supportive policies are needed to advance research, conservation, and documentation of neglected vegetable species to protect and further their role in nutrition-sensitive agriculture.

The eighth paper illustrates "BiodiverSO: A Case Study of Integrated Project to Preserve the Biodiversity of Vegetable Crops in Puglia (Southern Italy)" by Massimiliano Renna, Francesco F. Montesano, Angelo Signore, Maria Gonnella and Pietro Santamaria [13]. Puglia region (southern Italy) is particularly rich in agro-biodiversity, representing an example of how local vegetable varieties can still strongly interact with modern horticulture [1]. This article summarizes the objectives, methodological approach and results of the project "Biodiversity of the Puglia's vegetable crops (BiodiverSO)", an integrated project funded by Puglia Region Administration under the 2007–2013 and 2014–2020 Rural Development Program. Moreover, a case study is proposed on the Polignano carrot, a multicolored landrace of *Daucus carota* L. strongly linked with local traditions. Overall, the authors suggest that *in situ* conservation of genetic resources needs to be based not only on institutional programs, but mainly on the possibility, especially for young growers, to use these resources for productive activities which would facilitate a real income.

The ninth paper regards "Patterns of Genetic Diversity and Implications for In Situ Conservation of Wild Celery (*Apium graveolens* L. ssp. *graveolens*)" by Lothar Frese, Maria Bönisch, Marion Nachtigall and Uta Schirmak [14]. This study has been carried out to support *in situ* conservation actions regarding the wild ancestor of celery and celeriac in Germany. Seventy-eight potentially suitable genetic reserve sites representing differing eco-geographic units were assessed with regard to the conservation status of the populations. The authors determined the structures of genetic diversity within the sampled material as well as the differences in trait distribution between occurrences. The article recommended that 15 sites among those identified be used to form a genetic reserve network. This organizational structure appears to be suitable for promoting the *in situ* conservation of intraspecific genetic diversity and the species' adaptability. Moreover, the authors highlight that genetic reserves are conservation projects that require the support and active collaboration of local people without which a genetic reserve can neither be established nor maintained over an effectively long period.

The tenth article concerns the "Diversity of Cropping Patterns and Factors Affecting Homegarden Cultivation in Kiboguwa on the Eastern Slopes of the Uluguru Mountains in Tanzania" by Yuko Yamane, Jagath Kularatne and Kasumi Ito [15]. This paper focuses on the diversity of the cropping pattern observed in homegardens distributed on the eastern slopes of the Uluguru Mountains (Central Tanzania) and how this diversity developed. Participatory observation with a one year stay in the study village was conducted to collect comprehensive information and to detect specific factors about formation of diversity cropping patterns of homegardens. The authors indicated that the diversity of the cropping patterns observed in the homegardens in the target study village was influenced by factors related to regional characteristics such as the regional history and the customs and policies. In addition, ecological diversity, distributed on the slopes of the mountains from around 650 m to around 1200 m, also makes the cropping pattern diverse. The authors also highlighted a useful inductive method of analysis to facilitate an essential understanding of this ecological diversity.

3. Conclusions

In conclusion, the papers of this special issue cover a broad range of aspects and represent some of the recent research results regarding the topic of agro-biodiversity, which continues to be significantly relevant for both genetic and agriculture applications. We think that this special issue may stimulate further research in this area.

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