

Editorial

Medicinal and Aromatic Plants in Agricultural Research, When Considering Criteria of Multifunctionality and Sustainability ¹

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Over the last twenty years, agriculture has witnessed significant changes regarding energy requirements, advanced technologies and practices. This is in response to the impacts of crop production on the climate and environment and increasing awareness of the importance of agricultural sustainability through organic farming. Agriculture encompasses complex production systems, and certain aspects of multi-functionality and sustainability have become fundamental to these systems.

Agricultural activity can provide various functions in agro-ecosystems, such as producing food, managing natural resources, and conserving landscape and plant biodiversity, contributing to the cultural, historical and economic viability of rural areas. Agriculture must now adopt scientific innovations to produce food that consider not only human well-being and the environment but also the requirements of farmers. Aromatic and medicinal plants (MAPs), as open-field crops, can play an important role in multifunctional and sustainable agriculture, due to their low energy requirements for cultivation and their many uses, from the production of nutraceuticals, phytonutrients and phytotherapy to land valorization. Various MAPs are used in the food sector to flavor foods or prolong their shelf-life, while others are used in modern and traditional medicine in the production of phytocomplexes for human health and well-being. The cultivation of MAPs, when based on an integrated and sustainable approach, can contribute to the conservation of, and increase in, biodiversity in agro-ecosystems, as well as the recovery of degraded and marginal lands. One of the main aspects that highlights the quality of MAPs is the content and composition of essential oils, which are influenced by several factors, some of which depend on the plant (endogenous or genetic factors) and others on the environment (exogenous or environmental factors and biotic factors), while others concern the collection, preparation and conservation of the plant or the processed products.

On this basis, the main aim of the Special Issue “Medicinal and aromatic plants in agricultural research, when considering multifunctionality and sustainability criteria” is to illustrate the role of MAPs in agriculture under low-impact farming practices and the benefits they can generate in terms of functional products. A total of thirteen papers were published under this Special Issue, including twelve original research papers and one review article. Papers were submitted from six countries: Chile, China, India, Iran, Italy and Spain. The papers cover diverse scientific macro-areas related to MAPs, such as agronomy, chemistry and pharmacy, food and nutrition and ecology and provide new scientific data on natural products obtained from these species. In most papers (9), the authors investigated the effects of agronomic and environmental factors on the morphological, physiological and production characteristics of MAPs. In the remaining papers (4), the authors reported information on the biological activity of some MAPs and their metabolites, explained how MAPs could be used to enhance the quality of food products and provided technological data about the drying process of aromatic herbs.



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In this Special Issue, La Bella et al. [1] highlighted the effects of irrigation and peat-alternative substrates on the morphological, aesthetic and production characteristics of potted Sicilian rosemary (*Rosmarinus officinalis* L.) biotypes with different habitus types. The authors used four types of substrates with varying percentages of peat and perlite and irrigated the plants, integrating 100% field capacity every four days and every two days. They concluded that the greatest percent content in essential oil was obtained when irrigation events were less frequent, and that the substrates with 20% and 30% compost led to excellent performance results.

In a study carried out in Chile, Pinto-Morales et al. [2] reported the effect of different doses of compost on productive and physiologic parameters, including the polyphenolic composition and antioxidant activity of the fruit of calafate (*Berberis microphylla* G. Forst) grown under an intensive agronomic management. The authors demonstrated that the use of increasing doses of compost was beneficial to the physiological, productive, and quality parameters of the species but, at the same time, generated an increase in organic matter in the soil and the nutritional content of the soil.

In Italy, Angelini et al. [3] investigated different chemical and physical treatments to overpass seed dormancy and enhance the seed germination rates of *Passiflora incarnata* L. Different pre-germination treatments (pre-chilling, gibberellic acid, leaching, and scarification) were examined under different light and temperature conditions. The authors showed that the pre-germination treatments stimulated a faster germination compared to the control, with the best results obtained in the dark and with high temperatures.

In a study conducted in Spain, Fernández-Sestelo and Carrillo [4] estimated the effect of variable climate and fixed factors, such as soil and geographic location, on the essential oil yield and quality of 34 Spanish populations of spike lavender (*Lavandula latifolia* Medik). They found that the composition of the soil influenced the essential oil yield and quality, as well as some climatic and geographical factors such as rain and altitude.

Lazzara et al. [5] assessed the yield and phytochemical composition of three *Hypericum perforatum* biotypes, obtained from different Italian geographical areas, with contrasting cultivation methods, pot and open-field cultivation. The authors highlighted that the cultivation of *Hypericum* required a properly tuned cropping technique, along with a sound choice of the genotype to be cultivated. Furthermore, they stated that pot cultivation did not reflect the performance obtained from open-field cultivation.

Clemente et al. [6] evaluated the agronomic and qualitative performances of nine *Stevia rebaudiana* (Bertoni) genotypes cultivated in open field conditions, under the Mediterranean climate of central Italy. The authors found high variability among genotypes and provided useful information on the influence of crop age and harvest time in defining quanti-qualitative traits in stevia.

In another study, La Bella et al. [7] investigated the agronomic and production behavior of some caper biotypes (*Capparis spinosa* L. subsp. *rupestris*), identified on the island of Linosa (Italy) for growing purposes. This article takes an underused species, such as caper, into consideration, and highlights its agronomic importance in the context of Linosa island, identifying accessions of interest for the introduction of innovation into the new caper field.

In Iran, Izadi et al. [8] studied the propagation of rosemary (*Rosmarinus officinalis* L.) by stem cuttings and found that iron chelate application promotes root emergence and improves root and shoot biomass, leaf photosynthetic pigment concentrations and survival percentage. In China, Yang et al. [9] demonstrated that interplanting *Ficus carica* L. with *Taxus cuspidata* Sieb. increased the plant growth biomass, photosynthesis, soil organic carbon, total nitrogen, and secondary metabolites, such as psoralen and paclitaxel, with respect to monocultures. The authors stated that these results could provide a feasible theoretical basis for the large-scale establishment of *Ficus carica* and *Taxus cuspidata* mixed forests and obtain high-quality medicine sources for extracting psoralen and paclitaxel. In a study carried out in India, Singh et al. [10] explored the antiarthritic potential of different fractions of Swallow wort (*Calotropis procera* Aiton) for the evaluation of antiarthritic

potential using Freund's complete adjuvant model on wistar rats, as no such study has been carried out to date.

Regarding the impact of essential oil on the qualitative properties of food products, Barreca et al. [11] added different essential oils of Sicilian accessions of common sage (*Salvia officinalis* L.), oregano (*Origanum vulgare* L. ssp. *hirtum* (Link) Ietswaart), rosemary (*Rosmarinus officinalis* L.) and thyme (*Thymbra capitata* (L.) Cav.) to improve both the food shelf-life and aromatic flavour of extra-virgin olive oil. The results of this original study showed that no significant change in oleic acid percentage was detected in the mixture of extra-virgin olive oils with essential oil samples but seemed to highlight the presence of an antioxidant effect of essential oils of MAPs on extra-virgin olive oil.

Considering the technological aspects of MAPs, Catania et al. [12] designed a low-cost, real-time monitoring and control system for the drying process of sage (*Salvia officinalis* L.) and laurel (*Laurus nobilis* L.), and assessed drying efficacy in the microbial community associated with the studied MAPs. In particular, the authors found that the two species showed a different microbial stability with the adopted drying method and had a different shelf life.

In the only review included in this Special Issue, Rossini et al. [13] reported in-depth information on the cultivation, quality aspects, sustainable production and uses of hops (*Humulus lupulus* L.) in the Mediterranean area.

The thirteen papers in this Special Issue of "Medicinal and aromatic plants in agricultural research, when considering multifunctionality and sustainability criteria" represent an excellent contribution to scientific research on MAPs. More than one author contributed several papers to this Special Issue, exploring various research fields regarding MAPs. We believe that the data provided by all published papers can greatly improve the knowledge of MAPs and prove useful for researchers, technicians and students.

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