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Editorial

Advances and Sustainable Practices for the Rapidly Changing Field of Agronomy

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Human welfare is strictly linked to the Earth's natural resources, which are heavily exploited, thus making food production systems unsustainable [1]. Indeed, modern agriculture is currently enduring serious challenges to keep up with feeding an ever-growing population [1,2]. Therefore, agricultural practices demanding higher water use in addition to creating environmental pollution provoked by intensive agrochemical use are urgent matters related to sustainable agriculture in addition to the existing problem of the loss of biodiversity as a result of the misuse of lands [3] that are also suffering from degradation and salinization caused by chemical overuse [2]. Moreover, issues related to stress temperatures and scarce soil water regimes [4] as well as to water eutrophication [2] have also arisen. Therefore, sustainable agriculture is needed to decrease the damage caused by false practices that exhaust natural resources to limit the inputs and to preserve biodiversity and soil fertility [3]. In addition, precision agriculture helps to decrease the emission of greenhouse gases, enhances the resource-use efficiency, and optimizes the production and economic returns [5] by satisfying cultivated crop needs by means of adequate nutrient supplementation [6].

This Special Issue, "Selected Papers from the 1st International Electronic Conference on Agronomy (IECAG2021)", collects one review and seven original research papers dealing with precision and digital farming in addition to farming practices to achieve sustainable agriculture. This Special Issue shares scientific papers produced by research groups from Italy, Spain, Portugal, Russia, and Poland. As such, it provides new insights about sustainable and technological practices that are currently being applied.

For better N fertilization management that is in line with N uptake, Pampana and Mariotti [7] studied in two cities (Pisa and Arezzo) in central Italy through field experiments carried out over two years. The effects of the application rate, timing, and source of N on durum wheat in Mediterranean areas vulnerable to nitrate pollution were determined. The authors found that the production (biomass and grain) in both cities was less when the N application rate was based on the prescriptions of the action program (site-specific techniques) implemented in nitrate-vulnerable zones (100 and 120 kg N ha^{-1} for Pisa and Arezzo, respectively) instead of on the N requirements for crops (160 and 190 kg N ha^{-1} for Pisa and Arezzo, respectively). It should be noted that grain yield was dictated according to the influence of the climate influence in both scenarios, and this influence was higher in the first year. In addition, urea performed better than slow-release fertilizers as a source of nitrogen. The authors concluded that optimal fertilization strategies vary based on the environmental conditions of the location (temperature and rain fall). In the context of soil amendments, Bekier et al. [8] studied the use of biomass compost of willow (*Salix viminalis* L.) as a substrate component for the growth of *Lactuca sativa* L. The authors tested three variants of willow chip compost (alone, mixed with hay, or mixed with hay and mineral N fertilizer) in a pot experiment conducted in an experimental room. They assessed the effects of this compost at different stages of maturity on the germination of lettuce seeds and the initial growth of the seedlings. The results obtained from the preliminary studies indicated that willow chips require adequate additives (organic and mineral) and

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optimized compost conditions in order to be used as growing media. Because it does not contain any additives, it has inhibitory action on germination and growth; in addition, it should not be used as a single growing medium or amendment. The inclusion of hay (extensive meadows: 50% grasses, 25% legumes, and 25% other herbaceous plants) and mineral N fertilizer (ammonium nitrate 34% N) enhanced the compost process and the value of the fertilization effect of the compost under study.

Ikkonen et al. [4] and coworkers explored the aftermath of shungite employment on the respiration intensity of *Allium cepa* L., var. Sturon to temperature under two soil water regimes. The authors applied three concentrations of shungite in a pot experiment, filling the topsoil layer with umbric podzols and irrigating each pot differently (cycles of well-watering or dry wetting). It was found that when shungite is applied, its efficacy is related to the availability of water, which commands the temperature sensitivity response of the respiratory pathways (SHAM). SHAM-sensitive and SHAM-resistant pathways decreased with shungite application, indicating that it could play a major part in ameliorating plant respiration resistance to temperature drop. Moreover, to mitigate the effects of abiotic stresses such as high temperatures, different anti-transpirants products can be used. Cirillo et al. [9] applied pinolene and kaolin to two-year-old *Olea europaea* L. trees to mitigate the damage caused by high thermal stress, to enhance the physiological and biometric status, and to depict the bioactive compounds in the leaves. In this preliminary study, pinolene application was able to enhance shoot growth and the cross-sectional area of the trunk. It also reduced stomatal conductance, increased the relative water content leaves, and induced a higher photosystem II efficiency. Kaolin application resulted in a notable increase in the total polyphenol content as well as reduced stomatal conductance and engendered higher values of the SPAD index.

On the other hand, precision agriculture plays a considerable role in agricultural technology, with the aim of improving the use efficiency of resources and reducing inputs (e.g., water, fertilizers). Precision fertilization entails the urge to depict the variability of soil fertility. In this frame, Esteves et al. [5] conducted an experiment in a vineyard to depict diverse management zones by adopting soil electrical conductivity and the normalized difference vegetation index as indicators. Tests were carried out both separately and individually and were conducted under Mediterranean climate conditions and compared to the results of the analyzed soils. The results of this study demonstrated the importance of combining both indicators, which led to defining three categorical zones with reference to major crop nutrients and soil variables (total N, magnesium, exchange acidity, cation ratios, etc.). This strategy resulted in the recognition of an ionic unbalance, which was also due to excess Mg^{2+}. The authors concluded by pointing out the convenience of applying remotely sensed data and highlighted potential different soil management and crop nutrient application strategies throughout this vineyard. Such technological approaches can increase food production and have less of an impact on the environment if applied adequately. Within the framework of soil agrochemical properties, the implementation of machine learning methods grounded in applying predictors of spatial change is considered promising. Therefore, Sahabiev et al. [6] targeted the assessment of exploiting remote sensing data retrieved from two satellites (Landsat 8 OLI and Sentinel 2) as spatial predictors of chernozem soil properties. Spectral indicators together with soil properties were employed to generate digital maps of available forms of the different elements (N, P and K). The authors found that the application of the Random Forest and Support Factors algorithms based on the satellite data showed similar performance values. Decent predictions were acquired for the available N and K, whereas P was modeled less factually. In addition, the authors highlighted that when soil indicators such as soil texture and organic matter were included in the remote sensing-based machine learning models, the spatial predictions of N, P, and K were improved, thus leading to the creation of digital agrochemical maps on a single-field scale. In the same context of proximal remote sensing, Hamdane et al. [10] and coworkers used rapid and non-destructive assessment techniques such as proximal remote sensing and field sensors to evaluate the interaction between grafting and nematode presence on the physiological status of diverse crops. Within this scope, the authors compared proximal remote sensing devices to depict the roles of pepper, eggplant, tomato, and melon grafting on a resistant rootstock against *Meloidogyne incognita* in a greenhouse experiment using infested soil. Handheld SPAD and DUALEX sensors were used to measure leaf pigments; through RGB images, biomass and canopy vigor were assessed, whereas a spectroradiometer was implemented to assess the normalized difference vegetation index, and water stress was assessed by measuring stomatal conductance and plant temperature using an infrared thermometer. The authors found that the crop senescence index (CSI) and leaf flavonoid contents were sturdy root–knot nematode indicators, with fewer flavonoids and lower CSI being registered in the grafted plants. The sensor results illustrate that grafted plants have better physiological defense processes that improve yield. The authors concluded by emphasizing the promising results of proximal imaging in the field of agriculture. In the framework of technology and computer-generated imagery, Crimaldi et al. [11] overviewed the most diffused approaches that have been adopted to develop 3D tree models using functional–structural plant models and provided arguments for the methodologies and the available commercial software. They concentrated on approaches for rendering and modeling plants, focusing on their comparability with biological models and botanical knowledge (plant morphology, development and growth, and branching expression). They showed the possibility of creating a synthetic tree in a 3D real-time modeling environment from a mathematical biological model established using ordinary differential equations. The authors concluded that the additional flexibility in the model can be summed when the amount of light is calculated in the virtual environment using a proprietary shader; this calculation makes the modification of branching angles and growth possible, and thus the modeling of light competition between adjacent trees.

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References

1. El-Nakhel, C.; Geelen, D.; De Paepe, J.; Clauwaert, P.; De Pascale, S.; Rouphael, Y. An appraisal of urine derivatives integrated in the nitrogen and phosphorus inputs of a lettuce soilless cultivation system. *Sustainability* **2021**, *13*, 4218. [CrossRef]
2. Cristofano, F.; El-Nakhel, C.; Rouphael, Y. Biostimulant Substances for Sustainable Agriculture: Origin, Operating Mechanisms and Effects on Cucurbits, Leafy Greens, and Nightshade Vegetables Species. *Biomolecules* **2021**, *11*, 1103. [CrossRef] [PubMed]
3. Gomiero, T.; Pimentel, D.; Paoletti, M.G. Is there a need for a more sustainable agriculture? *Crit. Rev. Plant Sci.* **2011**, *30*, 6–23. [CrossRef]
4. Ikkonen, E.; Chazhengina, S.; Bakhmet, O.; Sidorova, V. Effect of Shungite Application on the Temperature Sensitivity of Allium cepa Respiration under Two Soil Water Regimes. *Biol. Life Sci. Forum* **2021**, *2*, 34.
5. Esteves, C.; Fangueiro, D.; Braga, R.P.; Martins, M.; Botelho, M.; Ribeiro, H. Assessing the Contribution of ECa and NDVI in the Delineation of Management Zones in a Vineyard. *Agronomy* **2022**, *12*, 1331. [CrossRef]
6. Sahabiev, I.; Smirnova, E.; Giniyatullin, K. Spatial Prediction of Agrochemical Properties on the Scale of a Single Field Using Machine Learning Methods Based on Remote Sensing Data. *Agronomy* **2021**, *11*, 2266. [CrossRef]
7. Pampana, S.; Mariotti, M. Durum wheat yield and N uptake as affected by N source, timing, and rate in two mediterranean environments. *Agronomy* **2021**, *11*, 1299. [CrossRef]
8. Bekier, J.; Jamroz, E.; Sowiński, J.; Adamczewska-Sowińska, K.; Kałuża-Haładyn, A. Effect of differently matured composts from willow on growth and development of Lettuce. *Agronomy* **2022**, *12*, 175. [CrossRef]
9. Cirillo, A.; Conti, S.; Graziani, G.; El-Nakhel, C.; Rouphael, Y.; Ritieni, A.; Di Vaio, C. Mitigation of High-Temperature Damage by Application of Kaolin and Pinolene on Young Olive Trees (*Olea europaea* L.): A Preliminary Experiment to Assess Biometric, Eco-Physiological and Nutraceutical Parameters. *Agronomy* **2021**, *11*, 1884. [CrossRef]

10. Hamdane, Y.; Gracia-Romero, A.; Buchaillot, M.L.; Sanchez-Bragado, R.; Fullana, A.M.; Sorribas, F.J.; Araus, J.L.; Kefauver, S.C. Comparison of proximal remote sensing devices of vegetable crops to determine the role of grafting in plant resistance to Meloidogyne incognita. *Agronomy* **2022**, *12*, 1098. [CrossRef]
11. Crimaldi, M.; Cartenì, F.; Giannino, F. VISmaF: Synthetic Tree for Immersive Virtual Visualization in Smart Farming. Part I: Scientific Background Review and Model Proposal. *Agronomy* **2021**, *11*, 2458. [CrossRef]